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Area
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Strategy

HUMBER RIVER WATER QUALITY MANAGEMENT PLAN 1986

Appendix A: Evaluation of Control Options

Ontario

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Forward

This appendix presents the results of the control option pre-screening exercise in the form of a one or two page summary sheet. Several options required a further detailed study beyond that contained in the summary sheet. For these options, identified in the table of contents, detailed reports follow the summary sheets.

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TAWMS CONTROL OPTION #1

Title:

Additional enforcement of existing plumbing codes with programs to trace and disconnect illegal connections to storm sewers.

Description of Option:

a) Provide additional enforcement of the existing plumbing bylaws to reduce the occurrences of illegal connections to the storm sewers.
b) For existing problems an action plan is required to trace and rectify the improper connections.

Effect:

Water Quality:

1. What parameters controlled?
   Bacteriological, BOD, nutrients, heavy metals, hazardous contaminants.
2. What source does it apply to?
   Illegal connections to storm sewers.
3. What problem in the environment is controlled and where?
   Dry weather pollution to the rivers.

Flood Control:

Cross connections can provide a route for stormwater to access into basements.

Treatment Costs:

Some reduction of treatment costs may be obtained by reducing cross connections of storm sewer flow to the sanitary system.

Economics:

1. Capital costs.
   Cost for correcting illegal connections can be high ($1K - $10K per connection).
2. Operating costs.
   Cost for tracing and bylaw enforcement could be substantial depending on the program.

Implementability and Social Impacts:

1. Likely implementor.
   Municipality - investigation/correction.
   Metro Toronto - inspection of illegal connection.
2. Impact on local residents.
   Can be significant if homeowners have to bear the cost for correcting illegal connections.
3. Jurisdictional conflicts.
   Potential conflict can arise if cause of cross connection not locatable. Homeowner vs Municipality conflicts as to who bears the cost.

Evaluation Methodology:

Review existing sewer maintenance programs with the municipalities. Develop an abatement/maintenance program for tracing and locating improper/illegal connections. Review municipal experience with plumbing bylaw enforcement.

Summary of Findings/Recommendations:

- Canadian Plumbing Code 1980 reviewed.
- Ontario Regulation 815/84 Plumbing Code reviewed.
- Reviewed existing sewer maintenance programs with the municipalities.
- Reviewed municipal experience with plumbing code enforcement.
- Reviewed status of Abatement Committee Action.
- Reviewed literature (NURP study outfall studies).

In conclusion, improper connections to the storm sewer system have been identified and corrected from both old connections and more recent connections. These connections may have originated by incomplete inspection during construction or by work carried out without the use of permits. For more details, refer to control option report to follow.

Listed below are suggested recommendations:

- Provide additional plumbing inspections during construction.
- Inform homeowners of the Requirements under the Ontario Plumbing Code and need to obtain plumbing permits.
- Inform homeowners of the possible penalties under the code and sewer use bylaws.

TORONTO AREA WATERSHED MANAGEMENT STRATEGY STUDY

CONTROL OPTION #1

ADDITIONAL ENFORCEMENT OF EXISTING PLUMBING CODE, WITH PROGRAMS TO TRACE AND DISCONNECT ILLEGAL CONNECTIONS TO STORM SEWERS

July, 1985

Prepared by:

B. Greck
TAWMS Project Staff

1. Introduction

As part of the TAWMS study several dry weather outfall studies have been undertaken. Water quality from several outfalls was found to be of poor quality and in exceedence of sewer-use bylaws. Pollutant discharges in dry weather have been known to have their sources from cross-connections between the sanitary and storm sewer systems. These inter-connections may allow sewage that is normally treated to enter into the storm sewer system and hence discharge pollutants (bacteriological, heavy metals, BOD, nutrients and hazardous contaminants) into the Humber River. The findings of the Nationwide Urban Runoff Program (NURP) identified illicit connections of sanitary discharges to stormwater sewer systems as a source of high bacteria counts and a danger to public health and a desirable "best management practice to pursue".

The purpose of this investigation is to discuss the use of additional enforcement of the existing plumbing code, and the use of programs to trace and disconnect improper connections to the storm sewer system as pollution control options.

2. Method and Results

The methodology used to investigate plumbing code enforcement and abatement programs was to review the existing plumbing codes and query the municipalities of concern.

Two plumbing codes exist; the Canadian Plumbing Code/1980 and the Ontario Regulation 815/84, plumbing code. The Canadian Code is a model plumbing code which contains requirements for the design and installation of plumbing systems and is drafted in such a way that it may be adopted or enacted for legal use by any jurisdictional authority in Canada. The Ontario Plumbing Code or Regulation 815/84 has set standards for materials and their installation to ensure protection of health, uniformity of requirements and good sanitary conditions. The code states "Inspection of plumbing under this regulation must be adequate to ensure that work meets their standards and that the other requirements of the regulation are complied with". This code is enforced under the Ontario Water Resources Act, and originates from the Ontario Building Code. Relevant sections from this code pertaining to the control of cross connections are listed on the following page.

The municipalities enforce the Ontario Regulation 815/84, plumbing code generally through their Building or Works Departments. Plumbing inspectors carry out inspections as required by the code at various stages of construction or as required for investigation. For various reasons inspectors may only have the plumber's word that connections have been made correctly. If there is any doubt the connections are tested. Testing each installation is generally

Ontario Plumbing Code - Relevant Sections

SECTION 1 General Requirements and Administration

Subsection 1.1. Application

1.1.1. No person shall construct, repair, renew or alter or cause or permit any person to construct, repair, renew or alter any *plumbing* system except in accordance with this Code.

Subsection 1.6. Service Connections

1.6.1. Every *drainage system* shall be connected to a sewage system referred to in Ontario Regulation 374/81, a public sanitary sewer, a public combined sewer or a *private sewer*.

Subsection 1.8. Inspection and Testing

1.8.1.(1) Every municipality shall carry out or cause to be carried out such inspections of *plumbing* as will establish the compliance or non-compliance of *plumbing* with this Code.

(2) No *plumbing* that has been constructed, repaired, renewed or altered shall be put into use until it is inspected and found to be in compliance with this Code.

(6) Where a municipality makes or causes an inspection to be made, the person calling for the inspection shall conduct any tests required by the municipality under Subsection 3.6 or 3.7 and the tests shall be observed by an *inspector*.

(10) Where a municipality at any time has reason to believe that the operation of any *plumbing fixture* or *appliance* connected to a *plumbing* system may,

(a) contaminate or endanger a *potable water* supply;

(b) leave or tend to leave any opening into a *drainage* or *venting system* within a building with less than one inch of water seal; or

(c) discharge waste from the *plumbing* system so that it becomes a nuisance or a source of water pollution,

or that a *service water heater* fails to meet the installation requirements set out in this Code, the municipality shall inspect or cause an inspection to be made so as to ascertain whether or not there is compliance with this Code.

Subsection 4.6. Arrangements of Drainage Piping

4.6.1.(1) No *vertical drainage pipe* shall conduct both *sanitary sewage* and *storm water*.

considered too time consuming and expensive. Inspections are carried out where plumbing permits have been obtained and there is some control over the work. It has been the experience of the municipalities to find problem connections for those works where permits have not been obtained.

The municipalities have procedures for tracing the illegal connections. These involve the use of wire baskets and dyes. However, outside of the TAWMS study, routine investigations or sampling do not exist. Problems are usually reported as a result of normal maintenance work and then investigated.

In general the municipalities have been successful in locating problems and rectifying the connections. The types of problems found are toilets in basements connected to storm sewers, cross-connections between the house and the main sewer and contaminated flows entering catchbasins from industrial yards. Industrial related cross-connections are dealt with by the Metropolitan Toronto Pollution Control Unit. Legal proceedings do not contribute to solutions and are avoided if possible. Fines are generally levied under the sewer use bylaw, not the plumbing code.

The cost for correcting improper connections varies greatly depending on the magnitude of work required. Average costs are $2.5K and could range from $100 to over $10K. In some municipalities financial assistance is available for correcting interconnections, provided a work permit was obtained during installation of the plumbing work.

The TAWMS study has established an Abatement Committee which has developed a set of guidelines to identify priority outfalls which require abatement action. These outfalls are presently under investigation to trace and correct the pollution sources. The guidelines are presently set for fecal coliform pollution and are being expanded to include chemically polluted discharges. The guidelines also contain criteria for removing the outfall from the priority list. The guidelines were developed only to produce a priority listing of problem outfalls. All problem outfalls are to be investigated.

3. Discussion

In addition to the benefits of reducing cross-connections for water quality reasons a possibility exists for some reduction in flooding problems as improper connections can provide a route for stormwater access into basements. Cross-connections also provide a source of extraneous flow to treatment plants during wet weather. The magnitude of these problems were not assessed in the TAWMS study and therefore the benefits to additional enforcement of the plumbing code for these problems is not known.

Costs for correcting improper connections can be significantly higher than those required to provide additional inspection at the time the plumbing work is carried out, as manpower is required to

both trace and correct the problem. In several cases tracing the problem may be very time consuming and inconclusive. This is due to the nature of some of the sources, i.e. not continuous.

4. Conclusion and Recommendations

In conclusion, improper connections to the storm sewer system have been identified and corrected from both old connections and more recent connections. These connections may have originated by incomplete inspection during construction or by work carried out without the use of permits. Preventing the existence of an improper connection is better than trying to trace and find the problem. Listed below are suggested recommendations based on the above findings.

1) Provide additional plumbing inspection during construction.
2) Inform homeowners of the requirements under the Ontario Regulation 815/84 plumbing code and the need to obtain plumbing permits.
3) Inform homeowners of the possible penalties under the code and sewer-use bylaws.

References

1. TAWMS, "Humber River and Tributary Dry Weather Outfall Survey", TAWMS, Technical Report #1, November, 1983.

2. TAWMS, "Don River Dry Weather Outfall Survey", TAWMS, Technical Report (Draft), June 1985

3. TAWMS, "Mimico Creek Dry Weather Outfall Survey", TAWMS, Technical Report (Draft), June 1985

4. United States Environmental Protection Agency, "Final Report of the Nationwide Urban Runoff Program", U.S. Environmental Protection Agency, Water Planning Division, Washington, D.C., 1983,

5. Response letters to questionnaire, from the Municipalities of Etobicoke, Metro, North York and York.

TAWMS CONTROL OPTION #2

Title:

Additional enforcement of existing sewer use bylaws.

Description of Option:

By providing additional enforcement of the existing sewer use bylaws, illegal use of storm and sanitary sewers may be controlled.

Effect:

Water Quality:

1. What parameters controlled?
   Bacteria, nutrients, solids, heavy metals, hazardous contaminants.
2. What source does it apply to?
   Primarily from industrial sources.
   CSO, storm sewer outfalls.
3. What problem in the environment is controlled and where?
   Dry weather contamination of the rivers.
   Aid in reduction of CSO

Flood Control:
Minimal, if any.

Treatment Costs:
Potential reduction in dry weather flow treatment costs.

Economics:

1. Capital costs.
   None.
2. Operating costs.
   Dependent on additional bylaw enforcement and inspection staff required.

Implementability and Social Impacts:

1. Likely implementor.
   Metro, Municipalities.
2. Impact on local residents.
   Minimal.
3. Jurisdictional conflicts.
   Jurisdictional problems may arise if the source of the problem is unknown, i.e. is it industrial or not.

Evaluation Methodology:

Review existing work in this area of sewer use bylaw enforcement:

- how are programs conducted
- what successes or improvements have occurred
- what penalties exist
- are the penalties effective

Summary of Findings/Recommendations:

- Violations of sewer-use bylaws, primarily from industrial sources exist. Effectiveness of bylaws cannot be determined.
- Existing bylaws are based on MOE/MEA (Municipal Engineers Assoc.) model bylaw. The model bylaw is currently under revision.
- It is recommended that the revised bylaw include parameters of present concern, e.g. metals, hazardous contaminants.
- A regular and systematic program by municipalities to check sewer outfalls during dry weather is recommended. Standardized documentation and reporting would be useful.
- For more details, refer to control option report to follow.

TORONTO AREA WATERSHED MANAGEMENT STRATEGY STUDY

CONTROL OPTION #2

ADDITIONAL ENFORCEMENT OF EXISTING SEWER USE BYLAWS

July, 1985

Prepared by:

B. Greck
TAWMS Project Staff

1. Introduction

Within each municipality a set of sewer-use bylaws exist to regulate the discharge of sewage and land drainage into the municipality's sanitary and storm sewer systems. The bylaws presently in use were derived from the Ministry of the Environment and the Municipal Engineers Association (MEA) model bylaw. Recent outfall sampling projects of dry weather discharges have identified several outfalls discharging concentrations greater than those set in the bylaws. Even though the bylaws are designed to govern the discharge to the sewer and not from the sewer, the samples do indicate that some violations may exist upstream.

Existing bylaws presently control the discharge of several parameters including bacteriological, nutrients, solids and heavy metals. A summary of municipal storm sewer-use bylaws are shown in Table 1. The enforcement of the sewer use bylaws will control the discharge from storm sewers and to some degree combined sewer overflows. Controlling these pollutant sources will control to some degree pollution problems found within the rivers and along the waterfront.

The objective of this report is to evaluate the use of additional enforcement of the existing bylaws as a pollution control option.

2. Method and Results

The evaluation methodology used was to review existing work in the area of sewer-use bylaw enforcement. The following paragraphs summarize the findings of the response to the following questionnaire sent to the municipalities of concern.

a) How are sewer-use bylaws enforced?
b) What penalties exist?
c) Are the penalties effective?
d) What success or improvements have occurred?

The municipalities, except Metropolitan Toronto, do not have regular programs to sample for violations of the sewer-use bylaw. If industries are suspected to be violating the bylaw, Metro Toronto is called in for an investigation. Metro has a regular program consisting of seven two-man crews who are Provincial Offence Officers who conduct regular sampling and surveillance of major watercourses. Sampling frequency varies from 1-6 times per year for industrial discharges depending on the industry's potential risks.

The penalty for contravening the sewer-use bylaw ranges from $50 for each violation to a maximum of $2K exclusive of costs for each violation. Each day in which a violation continues is considered a separate offense. In 1984 the courts levied fines totalling $87K for infractions of the Metropolitan Toronto bylaws.

TABLE 1. SUMMARY OF MUNICIPAL STORM SEWER-USE BYLAWS

PARAMETER	SYMBOL	UNITS	MUNICIPALITY OR REGION								
			YORK REGION	VAUGHAN	RICHMOND HILL	MARKHAM	BOROUGH OF EAST YORK	METROPOLITAN TORONTO	SCARBOROUGH	NORTH YORK	TORONTO
Aluminum	Al	mg/L	1	1	NA	1	1	1	1	NA	1
Ammonia (1)	NH_3	mg/L	10	10	NA	10	10	10	NA	NA	10
Arsenic	As	mg/L	1	1	NA	1	1	1	1	NA	1
Barium	Ba	mg/L	0.1	0.1	NA	0.1	1	1	1	NA	1
Cadmium	Cd	mg/L	0.1	0.1	1	0.1	0.1	0.1	0.1	1	0.1
Chlorine	Cl_2	mg/L	1	1	NA	1	1	1	1	NA	1
Chlorides	Cl	mg/L	NA	NA	1500	1500	NA	NA	NA	1500	NA
Chromium	Cr	mg/L	1	1	NA	1	1	1	1	1	1
Copper	Cu	mg/L	1	1	1	1	1	1	1	5	1
Cyanide	HCN	mg/L	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Fluoride	F	mg/L	2	2	NA	2	2	2	2	NA	2
Iron	Fe	mg/L	1	1	17	1	1	1	1	NA	1
Lead	Pb	mg/L	1	1	0.1	1	1	1	1	NA	1
Manganese	Mn	mg/L	1	1	NA	1	1	1	1	NA	1
Mercury	Hg	mg/L	0.001	0.001	NA	0.001	0.001	0.001	0.001	NA	0.001
Nickel	Ni	mg/L	1	1	1	1	1	1	1	NA	1
Phenolic Compounds		µg/L	20	20	20	20	20	20	20	40	20
Phosphorus	P	mg/L	1	1	NA	1	1	1	1	NA	1
Sulphides (2)	H_2S	mg/L	NA	NA	5	NA	NA	NA	NA	NA	NA
Sulphates	SO_4	mg/L	NA	NA	1500	1500	NA	NA	NA	1500	NA
Suspended Solids		mg/L	15	15	NA	15	NA	15	15	30	NA
Tin	Sn	mg/L	1	1	NA	1	1	1	1	NA	1
Zinc	Zn	mg/L	1	1	NA	1	1	1	1	5	1
Temperature		°C	65	65	65	65	NA	65	65	NA	65
BOD			15	15	15	15	NA	15	15	20	NA
pH		pH	6-9.5	6-9.5	5.5-9.5	5.5-9.5	NA	6-9.5	6-9.5	NA	NA
Coliform Count(3)		counts/ 100 mL	NA	NA	2400	2400	NA	NA	2400	NA	NA

Note: (1) As N
(2) As hydrogen sulphide
(3) Assumed to be fecal coliform

(Source: Don River Dry Weather Outfall Survey; TAWMS, 1986)

From the findings above, violations of the sewer-use bylaws do exist, primarily from industrial sources. However, what is not clear is if these contain several small violations or a few large violations, or if they are repeat violators. This information was not available at the time of writing, therefore, the effectiveness of these bylaws is not clear.

A difficulty which exists with using sewer use bylaws to control discharges to the receiving waters is that the bylaws are based on concentrations and not loadings, therefore, action cannot be taken when a discharge meets all the concentration criteria even if it has a large volume of flow.

Since the municipalities own their own sewers and have their own bylaws they should enforce their own bylaws. Presently most infractions are found from industrial sources and this falls under the jurisdiction of Metropolitan Toronto. Sewer use bylaws could also be used to control other pollution sources such as sewer system cross-connections and the dumping of wastes into the storm sewer from non-industrial areas. Enforcement of the bylaws whould have minimal impact on local residents; however, some jurisdictional problems may arise. Unknown pollution sources. i.e. industrial or not, will effect who would be responsible for investigation and follow-up actions.

3. Conclusions and Recommendations

In conclusion, enforcement of the sewer use bylaws is carried out on a routine basis by Metropolitan Toronto. However, one municipality enforcing the bylaw may not be adequate.

The model bylaws are presently under review and hence existing bylaws may be revised. The revised bylaw may require a different level of enforcement which is not clear at the time. At this time, enforcement of the existing bylaw should proceed as usual. However, those outfalls identified as problem outfalls should be checked for bylaw infractions for priority work.

References

1. TAWMS, "Humber River and Tributary Dry Weather Outfall Survey", TAWMS, Technical Report #1, November, 1983.

2. TAWMS, "Don River Dry Weather Outfall Survey", TAWMS, Technical Report (Draft), June 1985

3. TAWMS, "Mimico Creek Dry Weather Outfall Survey", TAWMS, Technical Report (Draft), June 1985

4. Response letters to questionnaire, from the Municipalities of Etobicoke, Metro, North York and York.

5. Bylaws from various Metro and York Regional Municipalities.

6. MOE/MEA model bylaw.

TAWMS CONTROL OPTION #3

Title:

Disconnect roof leaders discharging to sanitary and combined sewers.

Description of Option:

To disconnect roof leaders from sanitary and combined sewers and make the roof leaders discharge:

(a) onto pervious surfaces, e.g. lawn, or
(b) to the storm sewer system.

Effect:

Water Quality:

1. What parameters controlled?
   Dust and dirt on roofs and pollutants associated with stormwater contributing to CSO or extraneous flow to WPCP.
2. What source does it apply to?
   Roofs of residential and commercial buildings.
3. What problem in the environment is controlled and where?
   Reduce CSO to Black Creek. Reduce extraneous flow to Humber WPCP.

Flood Control:

Possible mitigation of local basement flooding. Ponding around buildings may result in seepage or runoff into basements.

Treatment Costs:

None (possibly some reduction in flows to WPCP).

Economics:

1. Capital costs.
   Option (a): $27M as estimated for Humber watershed; $2.5M for City of York.
   Option (b): Exceedingly high.
2. Operating costs.
   None.

Implementability and Social Impacts:

1. Likely implementor.
   Home owner at direction from municipality.
2. Impact on local residents.
   Requires alteration of roof leaders; costs to owners; poor surface drainage around building when ground is frozen.
3. Jurisdictional conflicts.
   Bylaws authorize mandatory flow restriction in designated combined sewer areas. Elsewhere, implementation relies on residents' co-operation. Bylaws require roof leaders to be connected to sewers (storm or combined).

Evaluation Methodology:

Estimate number of existing roof leaders and roof areas connected to combined sewers in City of York. Model simulation to estimate CSO reduction by disconnection. Estimate cost of disconnection and reconnection to storm sewers. Review literature and municipal sewer bylaws. For more information refer to detailed control option report to follow.

Detailed Costing

Avg. no of downspouts per dwelling = 2.3
Downspouts discharging to sewer = 86%
@ $100/downspout to disconnect

Households/ha estimated as follows:

	HOUSEHOLDS	AREA (ha)
Etobicoke	110,697	12,709
North York	197,147	17,985
1/2 of York	27,170	1,178
	335,014	31,872

$\frac{335,014}{31,872}$ = 10.5 households/ha

Area in Humber: 12955.9 ha

$$12955.9 \text{ ha} \times 10.5 \frac{\text{households}}{\text{ha}} = 136,037 \text{ households}$$

CAPITAL COST = $100 x 2.3 x 0.86 x 136,037 = $26,908,119 say $27M

NOTE: Entire catchment area is applied rather than just the residential area since the density of number of households is over the entire catchment area.

Summary of Findings/Recommendations:

- o City of York is served by combined sewers; cities of Etobicoke and North York are served by separate sanitary and storm sewers. Only a small area of the City of Toronto is in the Humber watershed.
- o Disconnecting all front leaders (25,000) in City of York would reduce CSO volume by 28%. Estimated cost $2.5 M for disconnection, $127 M for reconnection.
- o Not feasible to disconnect roof leaders near the rear of the houses
- o Limited literature related to this option; performance reports not found except for basement flooding mitigation.
- o Sewer bylaws require roof leaders to be connected to sewers.
- o This option not recommended except for basement flooding mitigation. Take abatement action on illegal connections to sanitary sewers if found.

References:

TAWMS, "Feasibility Study and Costing of Proposed Pollution Control Measures in Humber Sewershed", Technical Report # 9, Toronto Area Watershed Management Strategy Study, January, 1986.

Ministry of Municipal Affairs and Housing, "1984 Municipal Directory", Ministry of Municipal Affairs and Housing, 1984.

TORONTO AREA WATERSHED MANAGEMENT STRATEGY STUDY

CONTROL OPTION #3

DISCONNECTION OF ROOF LEADERS FROM SEWERS AS AN AID TO COMBINED SEWER OVERFLOW REDUCTION

June, 1985

Prepared by:

W. Wong
Water Resources Branch
Ministry of the Environment

1.0 Introduction

The Toronto Area Watershed Management Strategy Study (TAWMS) required a cursory assessment of the viability of disconnecting roof leaders from sewers as a means of reducing combined sewer overflow in the City of York's combined sewer area. This option was proposed for consideration because there is a belief that the option may be a cost-effective way to reduce sewer flow. The corollary is that reduced sewer flow will help reduce combined sewer overflow.

2.0 Method

The assessment was based on a brief review of the literature and relevant municipal sewer bylaws and based on the experience in the City of Stratford and in TAWMS own work. No additional computational analysis was required at this stage.

3.0 Literature Review

It is well known that an increase in surface imperviousness of a catchment, such as due to urbanization, will increase stormwater surface runoff. It is now generally recognized that it is beneficial to attenuate this increased flow. Some practioners in the stormwater management field have suggested that discharge of stormwater from roofs of buildings to a pervious surface instead of a sewer is one effective means to reduce stormwater surface runoff. For example, Pitt (1984) indicated that many cities were actively disconnecting roof drains from sanitary sewers, however, no examples were given.

The drainage manual (COA, 1980) indicates that this control measure can reduce the runoff coefficient for residential areas from 0.45 to 0.20. It concludes that discharge of roof leaders to a pervious surface should be practised in new developments wherever possible because roofs might contribute 50% of the impervious area in an urban development. The manual, however, does not address the issue of disconnecting existing roof leaders.

Some other authors mentioned infiltration of stormwater into the soil as a possible means of reducing surface runoff, but they did not specifically mention discharge of roof leaders to a pervious surface in this control method (Wisner, 1983; APWA, 1981).

Finnemore (1982) reported two cases of stormwater runoff control by applying the so-called "best management practices" in Bellevue of Washington and Montgomery County of Maryland. The discharge of roof leaders to a pervious surface was not mentioned in either of the cases.

Among the very limited literature that reports on actual results of roofs discharging to a pervious surface, it appears that the observations were focussed on local effects such as reduction in basement flooding (Vatagoda, 1982; Holmstrand, 1984). In the

latter case, the roof leaders discharged to specially constructed percolation basins. Holmstrand (1984) reported that the experience was mainly positive, but he cautioned that "... in some cases stormwater infiltration has been advocated as a non-failing, ready-made solution which might cause severe mistakes."

In summary, no indication was obtained from the literature review as to whether or not disconnecting roof leaders will reduce combined sewer overflow. However, this finding does not suggest that the control option should not be considered for mitigating local basement flooding. Furthermore, the finding should not be too liberally extrapolated to new developments, since the emphasis of the assessment is on roof leaders that already exist.

4.0 Stratford Demonstration Project

The City of Stratford is served by a nominally separate sanitary sewer system, but the city's water pollution control plant experiences high extraneous flow in wet weather. A study in 1972 for the city concluded that 29% of the homes in the city were connected to sanitary sewers and these connections were one of the sources of the extraneous flow.

In 1981, the city carried out a roof leader disconnection project. Two cases were studied. In one case, there were 27 homes in the catchment. Nine of the homes had roof leaders originally connected to the sanitary sewer and the roof leaders of six of these nine homes were disconnected in the experiment. The corresponding numbers in the other case were 25, 9 and 9.

The following abstract from the study report (Crozier, 1984) is self-explanatory:

> "A roof leader disconnection project was mounted in test catchments as a demonstration of this measure. The intent was to assess home owner receptivity to the measure, determine project costs, evaluate technical and implementation difficulties and to monitor the impact of disconnections on sanitary flows.
>
> In one case, test and control catchments were investigated; in another, before and after monitoring of a single catchment was undertaken. Rainwater leaders discharging to sanitary sewers were identified and disconnected wherever possible in the demonstration catchments. Discharges were directed to surface areas having adequate outlet. Disconnection costs averaged $256 per house or $186 per rainwater leader.
>
> Home-owner cooperation was good and in certain cases, where eavestroughs were being replaced in any event, disconnection was made voluntarily at no cost to the project. A voluntary program based on public education and technical assistance would likely be the most cost-effective approach to implementation of this measure.

Flow monitoring in the sanitary sewers did not demonstrate any clear impact of the disconnections on sanitary flows. Other sources of inflow, natural variability in sanitary flows and equipment problems obscured any influence the disconnections may have had."

5.0 TAWMS Results (TAWMS, 1986)

P. Theil Associates Ltd. (PTA) carried out a project in 1985 for the TAWMS to study inlet control as a means of reducing combined sewer overflow. PTA took the opportunity to run a simulation model for one storm event (34.6 mm precipitation) to compare the reduction in combined sewer overflow volume in two cases in a study area in the City of York. One case was the "as existing" case. In the other case, all the roof leaders in the study area that discharged to the combined sewers and were at the front of the homes were disconnected. The total roof area thus disconnected was 76 ha. Half of this roof area was then assumed to discharge to pervious surfaces and the other half to impervious surfaces such as driveways. The total number of roof leaders disconnected was 25,000. The total area of study was 630 ha with an imperviousness of 58% before disconnection.

PTA's findings are summarized below:

(1) It would be feasible to disconnect front roof leaders only, but not rear roof leaders because of unfavourable grading of the backyards.

(2) The total combined sewer overflow volume at the overflow regulators was reduced from 20,600 cubic metres to 14,900 cubic metres or 28%.

(3) The estimated cost of disconnecting the front roof leaders, at $100 per leader, would be $2,500,000.

(4) The estimated cost of providing an end-of-pipe detention tank of 20,600 cubic metres to completely contain the overflow would be $1,900,000 (51,000 cubic metres of storage was recommended at a cost of $4.7 million in TAWMS TR#7).

In summary, PTA's limited results indicated that roof leader disconnection would reduce the volume of combined sewer overflow, but the disconnection of a large number of roof leaders required for producing the result would be costly. The estimated cost for disconnection would be higher than $2,500,000 if the unit cost of $186 per roof leader as estimated by Stratford was used. Nevertheless, in another part of their study, PTA did recommend the disconnection of a small number of roof leaders to mitigate local basement flooding in certain locations in the study area.

6.0 Municipal Sewer Bylaws

The sewer bylaws of the three cities that make up the major part of the urban Humber sewershed were studied. Provisions in these bylaws concerning the disposition of stormwater from roofs are summarized below:

City of Etobicoke

All buildings (commercial, industrial, institutional or residential) must connect all roof drains to storm sewers where available. Contravention is an offence liable to a fine.

City of North York

Building shall be connected to sewers where available.

City of York

Buildings erected after 1978 with a roof area exceeding a specified size shall provide temporary detention on the roof (in the case of a flat roof) or be equipped with eavestrough flow restrictions (in the case of a pitched roof).

Buildings on certain specified streets, irrespective of the date of the building, may be required to be equipped with eavestrough restrictors.

7.0 Conclusions

- According to a limited review of the literature, there is no evidence that discharge of stormwater from roofs of buildings to pervious surfaces is a widely recommended means for reducing stormwater surface runoff. APWA (1981) advises that front and backyard ponding is not ordinarily desirable.

- Stratford's roof leader disconnection project did not produce conclusive evidence that roof leader disconnection would reduce the flow rate in the sewer. This finding, however was probably influenced by the relatively small number of roof leaders disconnected compared with the magnitude of the sanitary flow and other extraneous flows.

- Stratford's experience suggested that roof leader disconnection should best be pursued on a voluntary basis. This approach will inevitably result in piecemeal implementation and small effect in flow rate reduction.

- P. Theil's model simulation for one storm event found that by removing all the 25,000 front yard roof leaders in a study area in the City of York, the combined sewer overflow volume was reduced by 28%. The estimated cost of removing these leaders was $2.5 million, while $1.9 million would be needed to build a detention tank to completely contain the overflow. The roof disconnection option was therefore costly and ineffective in combined sewer overflow reduction.

- The cities of North York and Etobicoke (both serviced by separate sewer systems) do not require roof leaders to discharge to ground surfaces instead of sewers. In fact, the two cities require that buildings should be connected to sewers. In the City of York (serviced by combined sewers), new buildings may be required to attenuate the discharge of stormwater from roofs by detention or by eavestrough restrictors as applicable. As well, existing buildings on certain specified streets prone to basement flooding may be required to install eavestrough restrictors. Other than these special requirements, there is no provision in the city's bylaw stating that roof leaders should be connected or disconnected.

8.0 Recommendations

- Combined sewer overflow control for the Humber sewershed should not rely on augmentation by roof leader disconnection.

- Consider undertaking a roof leader disconnection demonstration project in either a storm sewer area or combined sewer area to augment the Stratford experience. The project should cover a sufficiently large pilot catchment to reduce the influence of interfering effects, the experiment duration should be sufficiently long; and the experiment procedure should be scientifically designed.

- If the findings of the demonstration project favour roof leader disconnection, municipalities should be encouraged to allow voluntary disconnection of roof leaders and amend the bylaws accordingly if necessary. Disconnection should be subject to house owner's prior notice to the city engineer to ensure feasibility, proper design and workmanship.

References

1. American Public Works Association (APWA), "Urban Stormwater Management", Special Report No. 49, 1981. p. 34 and p. 126.

2. Canada-Ontario Agreement on Great Lake Water Quality (COA), "Manual of Practice of Urban Drainage", Research Report No. 104, Ottawa, 1980, pp. 149-150.

3. City of Etobicoke, Municipal Code No. 213 as amended by Bylaw 1984-113.

4. City of North York, Bylaw No. 19209 as amended by Bylaws 20615, 20933 and 21093.

5. City of York, Bylaw No. 3003-78 as amended by Bylaws 3811-81, 3847-81, 3904-81, 4232-82, and 425-85.

6. Crozier, T. and Niedbala, M., "Municipal Experience in Inflow Control through Removal of Household Roof Leaders", Stratford/Avon Environmental Management Project, Jan., 1984.

7. Finnemore, E.J., "Stormwater Pollution Control: Best Management Practices", J. Environmental Engineering Division, ASCE, Vol. 108, Oct., 1982.

8. Holmstrand, O., "Infiltration of Stormwater: Research at Chalmers University of Technology, Results & Examples of Application", Proceedings of 3rd International Conference on Urban Storm Drainage, Goteborg, Sweden, June, 1984, Vol. 3, pp. 1057-1066.

9. Pitt, R., "A Proposal (for) the development of a Toronto Urban Runoff Prediction & Control Evaluation Model", TAWMS, Feb. 1984, p. 1.

10. TAWMS, "Feasibility Study and Costing of Proposed Pollution Control Measures in Humber Sewershed", Toronto Area Watershed Management Strategy Study, Technical Report #9, January, 1986.

11. Vatagoda, A. and Choudry, R., "Impact of Roof Leader Disconnection Practices on Basement Flooding", Proceeding 1982 Conference (SCE) Edmonton, Alberta.

12. Wisner, P. (Co-ordinator), "IMPSWM Urban Drainage Modelling Procedures", 2nd Edition, March, 1983.

TAWMS CONTROL OPTION #4

Title:

Reduce Erodibility of Surfaces

Description of Option:

(a) Paving of parking lots. May be impervious or pervious pavements.

(b) An alternative to paving would be regrading and providing buffer strips and grassed waterways to further encourage infiltration and reduce sediment loading to watercourses.

Effect:

Water Quality:

1. What parameters controlled?
   (a) Mainly suspended solids.
   (b) Suspended solids and associated pollutants (heavy metals, etc.)
2. What source does it apply to?
   Mainly from higher density residential, commercial, institutional and industrialized land uses, non-point source, stormwater runoff.
3. What problem in the environment is controlled and where?
   Erosion and sedimentation problems, i.e. sediment is a transport mechanism for pollutants and it affects the entire drainage network, i.e. sewers/catch basins as well as streams and lakes.

Flood Control:

Paving will increase the flow from impervious surfaces which will increase the runoff rate and runoff volume (in sewers as well as receiving stream). Employing pervious pavement or directing flow to grassed areas would avoid increases in runoff rate and volume.

Treatment Costs:

Regular impervious pavements in combined sewer areas would increase flow to WPCP for treatment thus increasing cost.

Economics:

1. Capital costs.
   Medium-cost of paving or installation of porous pavement in the form of concrete grids.
   Approximate installed cost of concrete grids is $45 per square metre.
2. Operating costs.
   Low periodic maintenance is required with porous pavements.

Implementability and Social Impacts:

1. Likely implementor.
   Municipality or private owner of commercial/industrial area. A bylaw would have to be enacted to control this problem.
2. Impact on local residents.
   Very good. Paved lots are preferable.
3. Jurisdictional conflicts.
   Yes, includes private properties. Difficult to enforce the option on existing areas.

Evaluation Methodology:

Review of the effectiveness of porous pavement as presented by R. Pitt (1985) in "Urban Runoff Controls Manual of Practice: for use with the Source Loading and Management Model (SLAMM)" as prepared for the TAWMS study. Cursory costing for installation of porous pavement. Analysis of urban stormwater loadings through the use of SLAMM may be possible at a later date.

Summary of Findings/Recommendations:

Porous pavements are generally either concrete grids with open holes which may be filled and have grass planted or an asphalt type pavement similar to regular asphalt. In a review by R. Pitt (Pitt, 1985) it was found that properly designed porous pavements could eliminate rainfall runoff for small rainfalls. Runoff coefficients from some laboratory tests of concrete grid pavements ranged from 0.06 to 0.26. The problems with porous pavements are generally wear and deterioration as well as clogging of the pores. Some minor maintenance may be required periodically to clean the pavement to prevent clogging. The cost of installing concrete grid pavement with grass in the holes would be approximately $45 per square metre. Porous asphalt pavement is extremely expensive, costs are on the order of four times greater than the costs for regular asphalt pavement. It is recommended that further investigation into the effectiveness of porous pavement for sediment control be performed to assess the viability of this control option, as well, the magnitude of the problem should be quantified.

References:

Pitt, R., "Urban Runoff Control Manual of Practice: for use with the Source Loading and Management Model (SLAMM)", prepared for the Toronto Area Watershed Management Strategy Study, April, 1985.

TAWMS CONTROL OPTION #5

Title:

Catchbasin cleaning

Description of Option:

The implementation or upgrading of catchbasin cleaning programs to provide cost-effective controls of pollutants from these sources.

Effect:

Water Quality:

1. What parameters controlled?
   BOD and solids associated pollutants such as heavy metals: little effect in controlling nutrients.
2. What source does it apply to?
   Storm sewers and combined sewers discharges.
3. What problem in the environment is controlled and where?
   Catchbasin cleaning would reduce total pollutant loadings to the river.

Flood Control:

None

Treatment Costs:

None

Economics:

1. Capital costs.
   Enhancing current program would cost $300K/every 6 yrs. for 3 additional vehicles.
2. Operating costs.
   Additional program cost is approximately $275K/annum at $10/catchbasin
   This cost allows for a catchbasin to be cleaned once to twice per year.

Implementability and Social Impacts:

1. Likely implementor.
   Local municipalities - catchbasin cleaning is an existing practice in most municipalities.
2. Impact on local residents.
   No social impact is expected on local residents.
3. Jurisdictional conflicts.
   No jurisdictional conflicts are expected.

Evaluation Methodology:

Literature review of past catchbasin cleaning experiences.

Detailed Costing

Costs reflect enhancing the current cleaning program from 0.5 - 1.0 x/yr. to twice the current cleaning frequency.

CAPITAL COST: catchbasin cleaning vehicle at $100K to be replaced every 6 years.

ANNUAL COST: Approximately $9 - $10/catchbasin - use $10/catchbasin cleaning (preliminary results from Canviro Consultants Ltd., 1986).

NUMBER OF CATCHBASINS WITHIN HUMBER WATERSHED

Average number of catchbasins/ha is 2.12 CB/ha (Gartner Lee Associates Ltd., 1983)

Humber Watershed area used: 12956 ha

@ 2.12 CB/ha = 27467 CB say 27,500 CB

@ $10/CB x 27,500 CB = $275,000

Approx. 3 vehicles are required to clean 27,500 CB/yr.

IF EXISTING PROGRAM IS DOUBLED:

cleaning frequency will be once to twice per year (1-2 x/yr.)

ADDITIONAL PROGRAM COSTS:

Annual : $275K

Capital : $300K every 6 yrs. (for 3 veh. @ $100K)

Summary of Findings/Recommendations:

Available literature provides conflicting information on the effectiveness of catchbasin cleaning for pollution control. Catchbasin cleaning may be effective for removal of solids and solids associated pollutants but less effective for nutrient removal. However, due to catchbasin design, sediment accumulation rates are generally found to be quite low and hence frequent cleaning is not warranted. The literature indicates twice a year should be sufficient.

A proposal is presently underway to assess the cost effectiveness of catchbasin cleaning based on literature available from previous lab and field studies. Preliminary results are expected by the end of January, 1986.

References:

Canviro Consultants Ltd., "Street Sweeping and Catchbasin Cleaning in the Humber River Sewershed", Preliminary Results, prepared for Ontario Ministry of the Environment, Toronto Area Watershed Management Strategy Study, Toronto, Ontario, 1986.

Gartner Lee Associates Ltd., "Storm, Sanitary, and Combined Sewer Mapping and Data Enumeration", Draft Report prepared for Ontario Ministry of the Environment, Toronto Area Watershed Management Strategy Study, Toronto, Ontario, July 1983.

Pitt, R., "Urban Runoff Control Manual of Practice: for use with the Source Loading and Management Model (SLAMM)", prepared for the Toronto Area Watershed Management Strategy Study, April, 1985.

Correspondence with municipalities.

TAWMS CONTROL OPTION #6

Title:

Enhanced street sweeping program

Description of Option:

Contamination from solids and solids associated pollutants which accumulate on road surfaces may be controlled by street sweeping. By reviewing and enhancing existing street cleaning practices, pollutant loads may be controlled in a cost-effective manner.

Effect:

Water Quality:

1. What parameters controlled?
   Total solids and heavy metals with some control of fecal coliforms and nutrients.
2. What source does it apply to?
   Loadings from storm sewers and combined sewer overflows.
3. What problem in the environment is controlled and where?
   Street sweeping would reduce pollutant loadings to the rivers.

Flood Control:

None

Treatment Costs:

None

Economics:

1. Capital costs.
   $2.9 M every 10 years.
2. Operating costs.
   Additional $1140/ann.

See detailed costing to follow.

Implementability and Social Impacts:

1. Likely implementor.
   Most roads, local and arterial, would be cleaned by the municipalities.
   Metro Toronto, MTC and private landowners would clean their own roads, highways or parking lots respectively.
2. Impact on local residents.
   Negative impact not likely.
   Possible positive impact by having more aesthetically clean roads.
3. Jurisdictional conflicts.
   Not likely a problem.

Evaluation Methodology:

The effect of street cleaning on urban runoff quality requires a relatively complex analysis. Currently a project is underway to obtain costing information and other data which will be used with the Source Loading and Management Model (SLAMM) to assess the cost-effectiveness of street sweeping.

Detailed Costing
- Enhanced Street Sweeping with mechanical sweepers
- does not include street flushing
- Program simulated - all streets are swept 3 x/wk.
  - watershed area is 12,956 ha

CURRENT PROGRAM (estimated from preliminary results by Canviro Consultants Ltd., 1986).

City of Etobicoke
Total Area = 12,709 ha
Mechanical Sweeping
Annual Cost $310K/ann.
7 mechanical sweepers
Frequency - 2 x/wk. for Arterial Roads
- Monthly for Residential Roads
Cost per hectare swept = $310,000/12,709 = $24.39/ha.

CURRENT PROGRAM

$24.39/ha x 12,956 ha = $316K to sweep Humber watershed.

	Frequency of Sweeping	
	Arterial	Resid.
Area of North York (17,985 ha)	1 x/wk.	2 x/month
Area of Etobicoke (12,709 ha)	2 x/wk.	1 x/month

Based on an estimated area (ha) distribution of:

	Etobicoke	North York
25% Arterial Rd.	3177	4496
75% Resid. Rd.	9532	13489

assuming 1/2 Etobicoke and 1/2 North York make up the Humber watershed then area swept : (17985 + 12709)/2 = 15,347 ha.

Actual watershed area = 12,956 ha
Application Factor = 12,956/15,347 = 0.844

Total ha swept/wk.

North York 4496 x 1 x 0.844 = 3795
13489 x 0.5 x 0.844 = 5692
9487

Etobicoke 3177 x 2 x 0.844 = 5363
9532 x 0.25 x 0.844 = 2011
7374

if 1/2 North York and 1/2 Etobicoke are in the Humber :
(9487+7374)/2 = 8430 ha/wk ; say 8400 ha/wk.

PROPOSED SWEEPING PROGRAM (3 x/wk. on all roads)

North York 0.5 x 17985 x 0.844 x 3 = 22769 ha swept/wk.
Etobicoke 0.5 x 12709 x 0.844 x 3 = 16090 ha swept/wk.
38859 ha swept/wk.

Existing sweeping program is 8400 ha swept/wk.
with approx. 8 vehicles

NEW PROGRAM IS:
38859/8400 or 4.6 times of existing program

No. of vehicles : 4.6 x 8 = 37 or 29 additional vehicles required

CAPITAL COST
@ $100K/veh. every 10 yrs.
$100K x 29 = $2900K every 10 yrs.

ANNUAL COST
$316K x 4.6 = $1454K or an additional $1140/ann.

The costs are based on preliminary results of Canviro's study, actual costs may vary depending on final results.

Summary of Findings/Recommendations:

Street cleaning performance tests were conducted in Toronto. Street cleaning is not expected to be very effective for control of urban runoff quality. Typical effectiveness could range from 1 to 11 percent removal of total solids loading. Nevertheless, this option is favoured by the municipalities because of its aesthetic benefits and its current implementation practice. Draft report of the costing project is expected by the end of January, 1986. Effectiveness of various levels of sweeping may be tested by SLAMM before this date.

References:

Canviro Consultants Ltd., "Street Sweeping and Catchbasin Cleaning in the Humber River Sewershed", Preliminary Results, prepared for Ontario Ministry of the Environment, Toronto Area Watershed Management Strategy Study, Toronto, Ontario, 1986.

Pitt, R., "Urban Runoff Control Manual of Practice: for use with the Source Loading and Management Model (SLAMM)", prepared for the Toronto Area Watershed Management Strategy Study, April, 1985.

United States Environmental Protection Agency, "Final Report of the Nationwide Urban Runoff Program", U.S. Environmental Protection Agency, Water Planning Division, Washington, D.C., 1983.

TAWMS CONTROL OPTION #7

Title:

Sediment control for urban construction and redevelopment

Description of Option:

Reduce erosion and sediment transport/delivery from sources such as unstable lands from improper construction, siting of road cuts, sewer construction, temporary disposal facilities.

Effect:

Water Quality:

1. What parameters controlled?
   Sediment and sediment associated pollutants.
2. What source does it apply to?
   Urban land use practices.
3. What problem in the environment is controlled and where?
   Reduce loading of solids to watercourse - reduce sedimentation, improve water quality in watercourses, impoundments and Lake Ontario nearshore.

Flood Control:

Benefit by reducing sedimentation - long term reduction in capital and operating costs of flood control structures.

Treatment Costs:

None.

Economics:

1. Capital costs.
   Medium; program dependent.
2. Operating costs.
   None, low.

Implementability and Social Impacts:

1. Likely implementor.
   Municipality.
   Land developer.
   MTRCA - off stream sediment control program.
2. Impact on local residents.
   None - benefit through improvement of properties, parklands, etc.
3. Jurisdictional conflicts.
   Some conflicts over agency responsible for causing problem, e.g. MTC, municipality, developer.

Evaluation Methodology:

Review MTRCA's experience with this problem. Need to identify significance of pollutants from these sources relative to others (e.g. from street washoff).

Summary of Findings/Recommendations:

MTRCA has no experience with redevelopment or urban construction. This option seems feasible and techniques similar to those for new development/construction may be employed. Review of stormwater study (Pitt, 1985) results may establish pollutant sources. It is recommended that municipalities address this problem on a case by case basis and administer control measures where practical.

Reference

Pitt, R., "Urban Runoff Control Manual of Practice: for use with the Source Loading and Management Model (SLAMM)", prepared for the Toronto Area Watershed Management Strategy Study, April, 1985.

TAWMS CONTROL OPTION #8

Title:

Dog Litter Control Programs

Description of Option:

Bylaws and education programs to control dog feces contamination. Dog feces could be controlled by a requirement on dog owners to "stoop and scoop" after their dogs. This would require residents to carry scoopers and disposal bags.

Effect:

Water Quality:

1. What Parameters are Controlled?
   Bacteria, nutrients, BOD.
2. What Source Does it Apply to?
   Dog feces in urban runoff.
3. What Problem in the Environment is Controlled and Where?
   Fecal bacterial contamination in rivers and lake-beaches; following wet events only.

Flood Control:

No Effect

Treatment Cost:

No effect

Economics:

1. Capital Cost
   None
2. Operating Cost
   Costs for public notification and enforcement; cost will vary depending on the program. City of Toronto's program with 4 enforcement officers cost $100K.

Implementability and Social Impacts:

1. Likely Implementor
   All municipalities within metropolitan Toronto in the Humber River watershed have "stoop and scoop" or dog litter bylaws. The bylaws generally require the dog owner to remove dog feces deposited on public property by their dog with fines against violators. The municipalities are responsible for enforcement; generally with bylaw enforcement officers.
2. Impact on Local Residents
   Some residents must purchase "scoops". Negative reaction from some residents, however, other residents who object to dog feces on streets and in parks would support the program.
3. Jurisdictional Conflicts
   None - Municipalities have their own bylaws.

Evaluation Methodology:

Low level qualitative evaluation. Review of existing bylaws. Obtain municipal opinion on implementability. Evaluate effectiveness with technique similar to that employed in the Rideau River Stormwater Management Study.

Summary of Findings/Recommendations:

Municipalities with bylaws against dog feces are actively enforcing the bylaws. The City of Toronto recently started a special enforcement program with four enforcement officers who distribute pamphlets at public parks to notify dog owners of the existing bylaw prohibiting dog litter. The City of York has a similar program with an enforcement officer patrolling the parks as well as distributing information booklets along with a package for cleaning up dog litter.

Enforcement of bylaws is generally very difficult since the number of dogs in the cities greatly outnumber the enforcement officers. However, part of the aim of the enforcement programs are to inform dog owners of the existing bylaws and expect that most reasonable dog owners will clean up after their dogs.

It was summarized in the Rideau River Stormwater Management Study's Technical Report # 21 (Pitt, 1983) that a dog feces control program such as "stoop and scoop" would result in a reduction of fecal coliform bacteria of up to 35% from dog feces reaching the receiving water. It appears that this control option would reduce the fecal coliform bacteria in the receiving waters and is worth implementing. Since some publicity and enforcement programs in some of the municipalities are in progress additional public awareness programs may be all that would be required to reduce the amount of dog feces in public parks and streets. For more details, refer to detailed control option report to follow.

TORONTO AREA WATERSHED MANAGEMENT STRATEGY STUDY

CONTROL OPTION #8

DOG LITTER CONTROL PROGRAMS

June, 1985

Prepared by:

M. Seto
TAWMS Project Staff

1. Introduction

Dog feces can be a significant source of bacteria in urban runoff. The dog feces deposited on land can be washed off with rainfall events. This results in bacterial loadings to the receiving waters with the storm runoff. A source control of dog litter would be a requirement of dog owners to clean up after their pets, such as bylaws which require dog owners to "stoop and scoop" dog feces.

The purpose of this control option is to review dog litter control bylaws and their implementability as well as public awareness programs. A low level qualitative evaluation is presented.

2. Methodology and Results

2.1 Evaluation Methodology

Copies of municipal bylaws on dog litter control were obtained and reviewed (appended). The municipalities were queried for their opinion on the implementability and problems associated with the bylaws.

The effectiveness of this control option was evaluated with a technique similar to that employed in the Rideau River Study. The dog population in the Humber River watershed south of Steeles Ave. is estimated from a dog population density estimate. Then the annual feces discharge to land is calculated based on a unit discharge per animal. The equivalent feces discharge to the river is taken as 0.01 of the discharge to land. The fecal coliform bacterial loading presented by Pitt (1983) was based on the concentration of fecal coliform (MPN/gram) in dog feces. With a source control such as "stoop and scoop", up to a 35% reduction in fecal coliforms is possible.

All municipalities in metropolitan Toronto within the Humber River watershed have bylaws prohibiting dog feces deposition on public property which requires the dog owner to "stoop and scoop" or clean up after their dog. The bylaws are all accompanied by fines against violators. The different dog control bylaws are summarized in the Attachment.

2.2 Results

The estimates of fecal coliform bacteria in the river from dog feces is based on the following computations as found in Pitt (1983).

Estimated dog population density: 4 animals/ha

Dog feces discharge to land: 100 grams/animal-day

Humber River watershed drainage area south of Steeles Ave.: 35960 ha

Estimated dog population in the Humber River watershed: 143,840 dogs

Annual Feces Discharge: 5.3 x 10exp9 grams/yr.

With an application factor of 0.01, the equivalent feces discharge to the river is 53 x 10exp6 grams/yr.

FECAL COLIFORM REDUCTIONS

% Fecal Coliform Reduction	Equivalent Feces Discharge to River (gm/yr)	Fecal Coliforms MPN/gm	MPN/yr.
0	53×10^6	23×10^6	1.2×10^{15}
10	48×10^6	23×10^6	1.1×10^{15}
20	42×10^6	23×10^6	960×10^{12}
35	34×10^6	23×10^6	780×10^{12}

3. Summary

Municipalities with bylaws against dog feces are actively enforcing the bylaws. The City of York has an enforcement officer patrolling the parks distributing information booklets and a package for cleaning up their dog's feces. The City of Toronto has started an enforcement program with four enforcement officers who hand out pamphlets at public parks to notify dog owners of the existing bylaw prohibiting dog litter. Generally the municipalities' aim is to warn violators of the existing bylaws and penalize repeat offenders who knowingly violate the bylaws with fines. The bylaws are being publicized by the various municipalities through the use of pamphlets and speeches at local neighbourhood meetings. The publicity programs are meant to make dog owners aware of the potential health problems associated with dog feces being deposited in parks and streets.

Some municipalities feel that enforcement of the bylaws is generally very difficult since the number of dogs in the city greatly outnumber the enforcement officers and the violators must be caught in the act of breaking the bylaw. It is anticipated that with a higher awareness of the potential health hazards of dog feces, dog owners will clean up after their pets.

As summarized in Technical Report #21 of the Rideau River Stormwater Management Study (Pitt, 1983), a dog feces control program such as "stoop and scoop" would result in a reduction of fecal coliform bacteria of up to 35% from dog feces reaching the receiving water.

Based on the information presented, it appears that this control option would reduce the fecal coliform bacteria in the receiving waters. Since the City of Toronto and the City of North York already have active enforcement programs, any further actions would contribute to this effort.

4. References

Pitt, R., "Urban Bacteria Sources and Control by Street Cleaning in the Lower Rideau River Watershed", Technical Report #21, Rideau River Stormwater Management Study, Ontario Ministry of the Environment, 1983.

THE CORPORATION OF THE BOROUGH OF YORK

APPROVED AS TO FORM
JUL - 1 '77

A BY-LAW

Number 2763-77

TO PROVIDE that owners of dogs must remove faeces left by their dogs in the Borough of York.

THE COUNCIL OF THE CORPORATION OF THE BOROUGH OF YORK ENACTS AS FOLLOWS:

- 1 -

Any person who owns, harbours or possesses any dog shall forthwith remove any faeces left by such dog from any place where the same has been left within the Borough of York.

- 2 -

Every person who contravenes the provisions of this By-law is guilty of an offence and is liable on summary conviction to a fine of not more than One Thousand Dollars ($1,000.00), exclusive of costs.

ENACTED AND PASSED this 15th day of August A.D. 1977.

ACTING MAYOR.

CLERK.

THE CORPORATION OF THE CITY OF YORK

ANIMAL SHELTER
2700 Eglinton Avenue West, Toronto, Ontario
M6M 1V1

ATTACHMENT : MUNICIPALITY BYLAWS

City of York

OUR PARKS ARE
FOR PEOPLE,
--TOO

PLEASE;

CLEAN:UP:AFTER

YOUR:DOG!

Protect your Pet, use a LEASH

when·walking your·dog

THE CORPORATION OF THE BOROUGH OF YORK

APPROVED AS TO FORM
Jul. 22 1976

A BY-LAW

Number 2464-76

TO AMEND Borough of York By-law Number 1085-71, being a By-law "TO ESTABLISH a Parks and Recreation Department of the Borough of York, and TO ESTABLISH standards and regulations for the planning, development, maintenance and operation of public parks, grounds, and boulevards within the Borough of York."

THE COUNCIL OF THE CORPORATION OF THE BOROUGH OF YORK ENACTS AS FOLLOWS:

- 1 -

THAT Section 16 of Borough of York By-law Number 1085 be and the same is hereby deleted, and the following inserted in its place as Section 16 thereof:

"

- 16 -

(a) No person shall permit any dog to enter upon any portion of any of the following parks:

Name of Park	Location
Cashman	Langmuir Crescent and Humbercrest Boulevard
Cayuga	Cayuga Avenue and Spears Street
Connaught Circle	Claxton Boulevard and Glen Cedar Road
Denison	Denison Road West and Lippincott Street We
Edinborough	Edinborough Court
Elm	Elm Street and Church Street
Florence Gell	Varsity Road and Althea Road
Gladhurst	Astoria Avenue and Elhurst Court
Glen Cedar	Glen Cedar Road and Warwick Avenue
Grattan	Grattan Street near Robert Street
Greenhills	Paulson Road and King George's Drive
Greyton Site	Greyton Crescent and Vaughan Road
Haney	Haney Avenue and Jane Street
Henrietta	Henrietta Street and Blakley Avenue
Holley	Weston Road and Parke Street
John Street	John Street between Pine Street and Elm Street
Memorial	Weston Road and Little Avenue
Merrill	Merrill Avenue and Macdonald Avenue
Nairn	Harvie Avenue and Chudleigh Road
North	Weston Road and St. Phillip's Bridge
Regent	Regent Street and Rogers Road
Rose Valley	Rose Valley Crescent and Black Creek Boulevard
Tichester	Tichester Road east of Bathurst Street
Winveun	Winona Drive and Vaughan Road
Old Mill Site	Old Mill Drive and Catharine Street

(b) No person shall permit any dog to enter upon any of the following facilities in any other park, namely:

tennis courts, bocce courts, soccer and football fields, baseball and softball diamonds, outdoor basketball, volleyball and badminton courts, arenas, community halls, swimming pools, natural ice rinks and playgrounds, including all areas where swings, slides, climbing devices, water areas and other apparatus used by children are located.

(c) No person shall permit any dog to run loose in any park, and in all parks not hereinbefore mentioned dogs may only be led on a lead not more than six feet (6') in length, or may be carrie

(d) No person shall lead or allow to be loose any other animal upon park premises. "

ENACTED AND PASSED this 26th day of July A.D. 1976.

MAYOR.

CLERK.

YORK'S ANIMAL CONTROL BYLAWS

STOOP & SCOOP

(Bylaw 2763-77)

Increasing population and development has reduced areas that once were available for exercising your dog. Now parklands and greenbelt areas are designed for our enjoyment and the health and safety of our children. For this reason the enforcement of the Bylaw that requires the owner/guardian of a dog to clean up after a pet (Stoop and Scoop) has become necessary.

BYLAW 2763 PROVIDES

Any person who owns - harbours or possesses any dog . . . shall remove any faeces left by such dog . . . from any place where the same has been left within the City of York.

PLEASE THINK OF OTHERS AND BE A RESPONSIBLE PET OWNER.

PROTECT YOUR NEIGHBOURHOOD . . .

DOGS AT LARGE

(Bylaw 1768-73)

Consider the serious consequences of failing to control your pet.

YOUR PET COULD . . .

- Contract a disease
- Eat a toxic food
- Bite someone
- Cause property damage
- Become injured or may never return home

NOTE:
The Dog Owners Liability Act provides: The owner of a dog is liable for damages resulting from a bite or attack by the dog on another person.

BYLAW 1768 PROVIDES

A dog shall be deemed to be running at large when found on a highway or other public place and not under control of any person . . . A dog at large may be seized and impounded and the owner charged with allowing a dog to run at large.

PLEASE PROTECT YOUR PET AND YOUR NEIGHBOURHOOD. KEEP YOUR DOG UNDER CONTROL AT ALL TIMES.

. . . YOUR PARKS . . .

YORK'S PARKS

(Bylaw 2464)

. . . No person shall permit any dog or any animal to run loose in any park within the City of York. This Bylaw requires all dogs to be led on a lead not to exceed two metres (6 feet) in length when on any of York's Parklands.

Dogs are prohibited to enter upon any portion of 25 of York's Parks as posted.

. . . Any area used as playgrounds, arenas, community halls, swimming pools, ice rinks, baseball diamonds, tennis and bocce courts . . . or other areas where apparatus is provided for exercise or children . . . prohibits dogs with or without a guardian.

THE STOOP AND SCOOP BYLAW APPLIES TO ALL AREAS OF YORK'S PARKLANDS.

City of York

City of Toronto

OFFICE CONSOLIDATION

This consolidation is prepared for purposes of convenience only; for accurate reference see by-laws as adopted by City Council

NO. 319-69 A BY-LAW

as amended by By-laws Nos: 95-70, 244-70, 234-71, 347-71, 180-72, 138-73, 166-74, 208-74, 325-74, 21-75, 611-77, 702-77, 439-78, 572-78, 735-78, 3-80, 206-80, 278-80, 467-80, 388-84, 391-84, 406-84, 731-84, 8-85, 101-85.

To Provide for the Regulation, Protection and Government of Park Properties in the City of Toronto, and Relating to trees on City Streets.

(Passed November 5, 1969)

Whereas the Council of the Corporation has authority to pass by-laws relating to trees on or over City Streets under an Act respecting the City of Toronto, being 1919 Ontario Statutes, Chapter 110, in addition to the authority contained in the Public Statutes of Ontario.

The Council of The Corporation of the City of Toronto enacts as follows:

PART II

13. No person shall

(10) as owner or person having the control of any animal, permit such animal to run unleashed in any City Park or swim in any water in any City Park;

(10) (a) Notwithstanding By-law No. 77-74, as amended, and subsection (10) of section 13 of By-law No. 319-69, as amended, dogs shall be allowed to run unleased at anytime in the areas more particularly described in Schedule "C" hereto attached and forming a part of this By-law, provided that all such dogs shall be under the control of a person. (388-84)

13.a.(i) Every owner of a dog present with the dog in a City Park at a time when the dog fouls the City Park with excrement shall forthwith remove the excrement; (391-84)

(ii) Notwithstanding section 18 of this By-law, every person who contravenes this section is guilty of an offence; (391-84)(8-85)

(iii) In this section "owner" of a dog includes a person who psssesses, controls of harbours a dog and "owns" and "owned" have a corresponding meaning. (391-84)

PART IV

18. (a) Every person who contravenes any of the provisions of Part II of this By-law is guilty of an offence and on summary conviction is liable to a fine not exceeding $1,000.00, exclusive of costs. (3-80)

§ 120-12. Administrative officer.

The Borough Clerk is charged with the administration of this Article.

ARTICLE II
Defecation on Public Property
[Adopted 1974-11-04 as By-Law No. 3409]

§ 120-13. Deposit prohibited.

No person shall deposit dirt upon any highway or bridge, including the sidewalks and boulevards thereon, by allowing any dog owned by such person to defecate thereon.

§ 120-14. Penalties for offences. [Amended 1977-04-25 by By-Law No. 4709[1]]

Any person convicted of a breach of any of the provisions of this Article shall forfeit and pay a penalty not exceeding the sum of two thousand dollars ($2,000.) for each such offence, exclusive of costs.

ARTICLE III
Spay/Neuter Clinic
[Adopted 1978-08-28 as By-Law No. 1978-230[2]]

§ 120-15. Establishment.

Effective January 1, 1979, a clinic for the spaying or neutering of dogs and cats, to be known as the "Borough of Etobicoke Spay/Neuter Clinic," shall be established, maintained and operated in the Borough of Etobicoke Animal Shelter located at the premises municipally known as "Number 146 The East Mall," in the Borough of Etobicoke.

[1] Editor's Note: Amended during codification; see Ch. 1, General Provisions, Art. II.

[2] Editor's Note: This by-law was adopted under authority of the Borough of Etobicoke Act, 1977, c. 81.

COUNCIL — The Council of the Corporation of the Borough of Etobicoke.

PARKS — Includes all lands, buildings (except those leased or rented by the Council to others from time to time, but only during the term of such rentals or leases), structures, equipment and waters under the control and management of the Council and heretofore designated as parks, and shall include all lands leased by the Council for park purposes from time to time, but only during the term of such leases, and those portions of any road right-of-way designated for park purposes. The parks indicated by names, being lands owned by the municipality, and shown on Schedule A attached to and forming part of this chapter,[1] are hereby designated as community recreation centres pursuant to the Community Recreation Centres Act, R.S.O. 1974, c. 80.

§ 190-2. Prohibited activities.

It shall be an offence for any person or persons to do any of the acts hereinafter specified within the limits of any of the parks listed in Schedule A attached to and forming part of this chapter:

A. Animals. To lead, ride or let loose any animals of any kind, provided that this shall not apply to dogs led by a leash being not more than six (6) feet long. If leading a dog by a leash as required, no person shall fail to clean up and dispose of such dog's feces.

B. Bicycles. To operate any bicycle elsewhere than on the roads or drives provided for such purpose and then only at a speed not to exceed twenty-five (25) kilometres per hour [fifteen (15) miles per hour].

C. Camping. To camp or lodge in any park or construct any shelter or pitch a tent without written permission of the Commissioner to do so in such areas or locations as may be designated by Council.

[1] Editor's Note: Schedule A is included in § 190-8 of this chapter.

§ 190-4. Issuing of permits.

Wherever in this chapter written permission of the Commissioner is required, the Commissioner is empowered to delegate to employees, servants and agents of the borough the authority to accept applications for and to issue the permits required under this chapter.

§ 190-5. Enforcement.

Designated employees or agents of the borough and any police officer are authorized to enforce the provisions of this chapter.

§ 190-6. Penalties for offences. [Amended 1981-11-30 by By-Law No. 1981-348]

Any person convicted of a breach of any of the provisions of this chapter shall forfeit and pay a penalty not exceeding the sum of two thousand dollars ($2,000.), exclusive of costs, for each offence.

§ 190-7. Application of fines.

All fines or penalties imposed under this chapter, unless otherwise provided, shall be paid to the Corporation of the Borough of Etobicoke.

§ 190-8. Schedule A, Parks.

A. Neighborhood parks.

Name	Hectares	Acres
Alderwood Memorial	1.42	3.50
Alexander	.11	.26
Allanhurst	.71	1.75
Beaumonde Heights	3.03	7.5

City of Etobicoke

CITY OF NORTH YORK

BY-LAWS RELATING TO ANIMAL CONTROL

The foregoing is for reference only. Copies of the By-laws may be purchased from the City of North York, Clerk's Department if desired.

BY-LAW #28261

Requires that every dog shall be licenced. Failure to comply may result in a penalty.

BY-LAW #28818

1. Every person who owns or harbours a dog shall keep the dog leashed and under the care and control of some person unless the dog is on the lands of the person who owns or harbours it. Whenever this By-law requires a dog to be leashed, the leash shall not exceed 2.4 metres (8feet) in length.

4. Every person who contravenes any of the provisions of this By-law is guilty of an offence and, on conviction, is liable to a fine not exceeding Two Thousand ($2,000.00) Dollars exclusive of costs.

BY-LAW #28020

1. No person who owns or harbours a dog shall permit the dog, whether leashed or unleashed, to trespass on private property.

2. (1) Every person who owns or harbours a dog shall forthwith clean up and dispose of any excrement left by the dog on any property, public or private, in the City of North York.

4. Every person who contravenes any of the provisions of this By-law, is guilty of an offence and on summary conviction is liable to a fine of not more than One Thousand ($1,000.00) Dollars exclusive of costs.

BY-LAW #24368

2. No owner of a dog shall allow it to run at large in the City of North York.

SCHEDULE OF FEES

2. $10.00 for a dog impounded for the first time;

$30.00 for a dog impounded for the second time within a period of two years from the time it was first impounded;

$45.00 for a dog impounded for the third time any any subsequent times within a period of two years from the time it was first impounded.

6. For the purposes of this By-law, a dog shall be deemed to be running at large when found on public lands or in a public place and not under control of any person.

7. Every owner of a dog who allows it to run at large contrary to the provisions of this By-law is guilty of an offence and on summary conviction is liable to a fine.

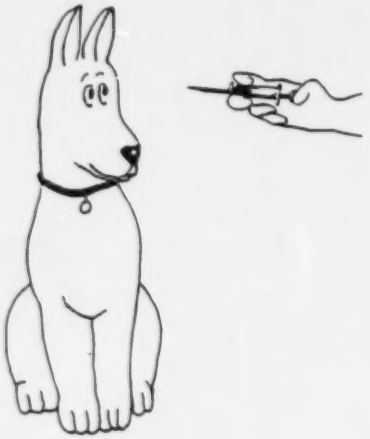
September, 1983

Help!

Donations to the City's spay-neuter program and other programs to promote animal welfare are gratefully accepted. Receipts for income tax purposes will be issued on request.

Emergency!

Car accidents and other emergencies can happen at any time. The City of North York provides a 24 hour emergency service for injured stray animals. No matter what the hour, no matter what the injury, Canine Control staff are there to help.



Rabies

It's a deadly disease. The best protection for both people and animals is to have the family pet vaccinated against rabies. See your veterinarian, and watch for the City of North York's Rabies Vaccination Clinic in the Spring of 1984.

Protect your pet

Make sure a veterinarian examines your pet at least once a year. Annual vaccinations against diseases such as distemper are highly recommended.

City creatures

Almost everybody enjoys watching urban wildlife going about their business. That is, until their business interferes with our business. The City of North York helps out by removing wildlife, secure in a proper box-type trap, from private property at the owner's request. There is no charge for this service.

North York, the City with a Heart, cares about animals, too. For further information, contact:

City of North York
Canine Control
1 Tuscan Gate
North York, Ontario
M3J 2T5

Hours:
Monday - Friday, 7:30 am to 3:00 pm
Saturday, 12 noon to 4:00 pm
Phone: 633-1600

After Hours:
Emergencies only, phone: 224-6433

CITY OF NORTH YORK

Canine Control

Pet Sense!

City of North York

Does your dog carry identification?

No matter how careful most pet owners are, some animals manage to wander off and become lost or injured. To make sure your dog can be easily returned to you, firmly attach its licence to its collar. Dog licences must be renewed by January 10th of every year. It's not only good sense, it's also the law. (By-law 28261)

Love your dog?

Then leash it. The good life for a dog is *not* roaming the neighbourhood on its own. A dog at large can get into garbage and cause a nuisance. It can frighten or even bite children and cause serious problems. It can get hit by a car; it is in danger. Because of this, the City of North York insists that a dog off the owner's property must be on a leash of no longer than 2.4 metres (8 feet) — with a person holding the other end. It's not only good sense, it's also the law. (By-law 28818)

Get the scoop!

Little is more annoying than accidentally discovering the mess of someone else's dog. Owners who refuse to clean up after their pets are not only being unsanitary, they also cause bad feelings between neighbours, and towards dogs. The City of North York requires that if your dog defecates on public or private property, you clean it up. It's not only good sense, it's also the law. (By-law 28020)

Barking — a noisy nuisance

It's usually the lonely, bored dog that howls or barks. Usually, this only happens when the owner is away from home. Ask your neighbours to tell you if your dog barks when you are away. If so, train your dog out of this habit. Help is available from veterinarians, dog trainers and the public library. The City of North York insists that neighbourhood dogs do not cause a disturbance. It's not only good sense, it's also the law. (By-law 24654)

Pet population control

It's a simple fact: there are too many unwanted pets. Don't let your animal be part of the problem. Have it spayed or neutered. The City of North York takes this problem seriously. It operates a subsidized spay neuter clinic for its pet-owning residents. Financial assistance is available for those who cannot afford the clinic fees. Licence costs are reduced for spayed or neutered dogs. Have your pet spayed or neutered. It makes good sense.

Teacher's pet

That's "Scruffy", North York's two year old Pound Mascot. "Scruffy", along with one of North York's Canine Control Officers, visits the City's schools on invitation to talk to children in Grades 1 to 8 about how to be a good, law-abiding pet owner. Ask your child's teacher about arranging for "Scruffy" and friend to visit the class. An educated pet owner is a responsible pet owner.

City of North York

TAWMS CONTROL OPTION #9

Title:

Bird control measures

Description of Option:

Bird population in general is not considered controllable. Wild fowl in specific beach areas may be controllable, by removal or converting grass areas to sand. Wild fowl on the Humber River flood plain and marsh area are not considered controllable.

Effect:

Water Quality:

1. What parameters controlled?
   Bacteria, nutrients.
2. What source does it apply to?
   Non point distributed source. River and beach direct pollution.
3. What problem in the environment is controlled and where?
   Beach and river bacterial contamination.

Flood Control:

No effect.

Treatment Costs:

No effect.

Economics:

1. Capital costs.
   None.
2. Operating costs.
   Removal has some cost.

Implementability and Social Impacts:

1. Likely implementor.
   Environment Canada Wild Life Services, MTRCA.
2. Impact on local residents.
   Segment of public strongly resists any control.
3. Jurisdictional conflicts.
   None known.

Evaluation Methodology:

None.

Summary of Findings/Recommendations:

Not a viable option on the Humber. May be considered for Beaches.

TAWMS CONTROL OPTION #10

Title:

Disposal Facilities and Public Education Programs for Household Hazardous Waste Management

Description of Option:

(a) Program to inform/educate the public of the existence, potential hazards and safe handling of Household Hazardous Waste (HHW) in and around the home. Education may be through various media: product labelling, public demonstration, schools, films, etc.

(b) Provision of public disposal facilities and programs for household hazardous wastes.

Effect:

Water Quality:

1. What parameters controlled?
   Exact parameters requires investigation. Generally from 129 priority pollutants plus other HHW - most are not found in pure form, rather as commercial compounds.
2. What source does it apply to?
   Storm, sanitary and combined sewers.
   Runoff from lawns, roofs and driveways.
   Leachate from land disposal if HHW is disposed of at landfills.
3. What problem in the environment is controlled and where?
   surface waters and sediments: aquatic life, water contamination and direct body contact.

Flood Control:

No effect.

Treatment Costs:

Effect on present treatment costs would be limited (this would depend on disposal methods as well as material disposed).

Economics:

1. Capital costs.
   Program costs:
   Collection program, dependent on collection method - depot vs. door to door collection; generally depot collections are not as expensive to operate.
   Education program - costs can be significant.
2. Operating costs.
   Disposal costs - varies with the disposal methods.
   Staffing costs - staffing costs are a very significant portion of the total program costs.
   Overall program cost for two one-day depot collections in the Region of Waterloo cost $17,000 in 1983.
   (costing example may be found in RIS Consult. report.)

Implementability and Social Impacts:

1. Likely implementor.
   The implementor of the collection programs would generally be the local municipalities. Possibly provincial and federal governments as well. The actual operation of the facility and disposal of the household hazardous wastes may be contracted to a private special hazardous waste handling firm.
2. Impact on local residents.
   Residents may wish to use alternative products rather than HHW. Minor additional effort would be required to participate in HHW collection programs.
3. Jurisdictional conflicts.
   Possibly several implementors or municipalities may be involved. Location of disposal sites may require agreement between municipalities, but generally there would be little conflict.

Evaluation Methodology:

Review existing and past HHW collection and public education programs. Address any special precautions and costs required for operating collection and disposal facilities. Identify potential collection and disposal facilities. Identify hazardous wastes around the home.

Summary of Findings/Recommendations:

The Ontario Ministry of the Environment's Waste Management Branch is in the process of finalizing guidelines to aid municipalities in implementing programs for the management of household hazardous wastes. The guidelines will outline the steps in organizing a HHW collection program, as well as address topics of safety, collection, disposal and publicity of the program. The collection and disposal of the HHWs would usually be handled by a specialized hazardous waste management company. With a depot-collection system landfill sites are commonly used as a collection point (not disposal).

Review of past HHW collection programs indicate that public education and publicity of HHW collection programs are essential towards the success of the program. The public needs to be better educated of the adverse environmental impacts and dangers of carelessly discarding HHW or even disposal through regular garbage collection.

References:

Resource Integration Systems Inc., "Household Hazardous Waste Management - the North American Experience", Resource Integration Systems Inc. Report to MOE's Waste Management Branch, June, 1985a.

Resource Integration Systems Inc., "Guide to Inplementing Household Hazardous Waste Collection Programs", Resource Integration Systems Inc., Report to MOE's Waste Management Branch, June, 1985b.

TORONTO AREA WATERSHED MANAGEMENT STRATEGY STUDY

CONTROL OPTION #11

STORMWATER DETENTION PONDS FOR QUALITY CONTROL OF RUNOFF AND SPILLS IN INDUSTRIAL AND COMMERCIAL AREAS

JUNE, 1985

Prepared by:

V.I. Chin
Water Resources Branch
Ministry of the Environment

Summary of Findings/Recommendations:

Stormwater detention ponds for quality control, based on the limited available studies, can be 80-90% effective in reducing sediment loads if properly designed. Although no information was found on the control of spills, it is this author's opinion that the design of an appropriate baffle near the pond inlet could be used for control of immiscible liquids (e.g. oils).

Four sites have been short-listed and studied; three in Etobicoke and one in North York (TAWMS, TR#9, 1986). All four sites were found feasible. Total catchment area is 2,164 hectares of which 60% is industrial land use.

Estimated total capital cost is $4.4M for industrial ponds and $15.1M for residential ponds throughout the basin, exclusive of land cost. Pond costs range between $654 and $3,186 per hectare of catchment area. An average pond cost of $1500/ha of catchment area was used (TAWMS, TR#9, 1986). Annual operating and maintenance costs provided in TAWMS TR#9 is in the range of $1733 to $2052 per hectare of pond area depending on landuse. An average cost of $1900/ha was used resulting in annual costs of $56K and $96K for industrial and residential ponds respectively.

Since little information on firm pond design criteria and effectiveness is available, it is recommended that the ponds be constructed in stages as pilot projects. Staging would allow pond effectiveness to be evaluated and design modifications to be incorporated in later-constructed ponds.

Priority of pond construction, based on least unit cost and industrial area controlled, should be given to the following locations in the order of their listing:

1) Etobicoke - Islington and Saskatoon ($425,000)
2) North York - St. Lucie and Storer ($1,184,000)

These two ponds account for about 75% (980 ha) of the total industrial area for 50% of the total cost. Consideration of the remaining two ponds which have considerably higher unit costs should await construction and evaluation of the two priority ponds. For more details, refer to the detailed report to follow.

Evaluation Methodology:

Select catchments of reasonably large size (over 100 ha) to avoid miniature ponds and reduce unit costs. Examine feasibility and availability of pond sites. Determine pond sizes to maximize utilization of pond wherever site conditions permit. Estimate costs. Estimate pollutant reduction in pond, using SLAMM model.

Detailed costing:

Industrial Ponds

Stormwater detention ponds for quality control of runoff from industrial landuse areas. Provide storage for 20 mm of runoff.

Industrial catchment area used: 2913.3 ha
Avg. cost of $1500/ha of catchment area
CAPITAL COST: 2913.3 ha x $1500/ha = $4,369,950 say $4.4M
ANNUAL COST: $1900/ha of pond area
Pond area assumed to be approximately 1% of catchment area (29.1 ha)
29.1 x $1900/ha = $55,290/ann. for maintenance.

Residential Ponds

Stormwater detention ponds for quality control of run off from residential landuse areas.
Provide storage for 20 mm of runoff.

Residential catchment area used: 10,042.6 ha
Average cost of $1500/ha of catchment area.
Pond area assumed to be approximately 1/2% of catchment area 50.2 ha)
CAPITAL COST: 10.042.6 ha x $1500/ha = $15,063,900 say $15.1M
ANNUAL COST: 50.2 ha x $1900/ha = $95,380 for maintenance.

Land Cost (provided by MTRCA)

LOCATION	AREA(ha)	TOTAL COST($)	COST/ha($)
Emery Creek (St. Lucie Dr.-Storer Dr.)	7.9	73K	9.2K
West Humber River (Martin Grove Rd.)	3.5	26.1K	7.5K
Main Humber River (Norfield Cres. area near Albion Rd.)	3.7	37K	10K

Residential Ponds — Average land cost : $9K/ha
pond area of 50.2 ha
cost : $452K

Industrial Ponds — Average land cost : $9K/ha
pond area of 29.1 ha
cost : $262K

TAWMS CONTROL OPTION #11

Title:

Stormwater detention ponds for quality control of runoff and spills in industrial and commercial areas.

Description of Option:

Ponds assumed to be plain sedimentation ponds, including skimming. Not meant for control of spills outside of catchment.

Effect:

Water Quality:

1. What parameters controlled?
   Solids-associated pollutants.
   Spilled pollutants-petroleum products.
2. What source does it apply to?
   Storm sewer outlets in catchments having high concentration of commercial/industrial land uses.
3. What problem in the environment is controlled and where?
   Reduce solid-associated pollutant loads to receiving water; contain accidental spills.

Flood Control:

No.

Treatment Costs:

No.

Economics:

1. Capital costs.
   Pond cost likely to be high. Land cost will depend on location and existing and planned use. Estimated cost is $4.4M for industrial ponds and $15.1M for residential ponds.
2. Operating costs.
   Low. Periodic de-silting and servicing of equipment and maintenance of works, estimated at $56K/ann. and $96K/ann. for industrial and residential ponds respectively. Unpredictable for cleaning accidental spills. See detailed costing.

Implementability and Social Impacts:

1. Likely implementor.
   Local municipalities. Municipality must have spill response program (see Option #12).
2. Impact on local residents.
   Not significant if pond properly maintained; otherwise may cause nuisance, e.g. mosquito breeding, algae growth. Possible long term adverse effects of proliferation of local ponds to be considered.
3. Jurisdictional conflicts.
   Possible debate of cost-sharing and operation. Land use conflict - use of flood plain. If in flood plain, then a permit required under the Lakes and Rivers Improvement Act.

1.0 Introduction

Stormwater detention ponds, also referred to as detention basins, have become an accepted practice in many countries for management of stormwater from urban areas over the last decade. Ponds designed for water quantity control are the more common practice and only a few examples of ponds specifically designed for quality control are available.

The purpose of this report is to evaluate, through a review of existing literature, the performance and effectiveness of existing stormwater management ponds for quality control in the TAWMS area. Four sites have been short-listed for a detailed feasibility study.

2.0 Discussion

2.1 Effectiveness

The effectiveness of stormwater detention ponds for quality control was recently reviewed by Chin (1985) and Pitt (1985). Suspended solids has been reported in the literature most frequently and is used here as a surrogate parameter. No information was found on the control of spills. The ensuing paragraphs summarize the results of the most recent literature reviews.

Fourteen ponds were studied as part of the Nationwide Urban Runoff Program (NURP) and were categorized as being either a dry pond, wet pond or dual-purpose pond (USEPA, 1983). In terms of the ponds' performance for suspended solids removal, dry ponds were found to have low effectiveness. Dual-purpose ponds were found to be moderately effective but had only limited data. Wet ponds' effectiveness ranged from very poor to excellent; the anomalies could not be explained. However, when adequately sized and designed, wet ponds can provide 80-90% removal of suspended solids. Similar results are reported from other areas in Pitt's (1985) review.

Five Canadian ponds were reviewed: one in Ottawa (Gietz, 1983), two in Mississauga (Brydges and Robinson, 1980) and two in Winnipeg (APWA, 1981). Four of the ponds were relatively large with ratios of pond area to catchment area ranging between 2.2 and 9.3 percent. These ponds provided 80-90% removal of suspended solids. The small pond which had a pond/catchment ratio of 0.43 percent provided about 30% removal of suspended solids. Driscoll (1983) suggests that pond/catchment ratios of approximately 1% to be adequate for 90% removal of suspended solids.

2.2 Design

At present there are no firm criteria for design of stormwater detention ponds. Major design factors governing the effectiveness of ponds are pond volume, pond/catchment ratio, hydraulic loading rate, and outlet design, which are discussed in APWA (1981), Pitt (1985) and Chin (1985). Other design factors not related to removal

effectiveness are safety, liability, odours, insects, algae growth, sediment removal and maintenance, etc., which are discussed in Mulamoottil (1977), Baxter, et al. (1985) and Pitt (1985). Pond design for 80-90% suspended solids removal appears feasible. These and other factors do not appear to be a major obstacle to pond construction.

2.3 Capital Costs

A review of construction costs for stormwater detention ponds (Chin, 1985) indicated costs, exclusive of land costs, ranging between $300-$16,000 per hectare, with an average of $4,600 per hectare of developed catchment in Ontario. Catchment areas ranged between 12-1,012 hectares, with an average of 137 hectares. Some of the larger unit costs are associated with small areas of development. The data base does not allow scrutiny of the pond volumes. Ponds are likely sized for flood control purposes which require larger volumes than for quality control; consequently, some unit costs may be on the high side as compared to quality control ponds.

Construction costs in the U.S. are reported to range between $1,800-$5,300 per hectare of catchment area for on-site ponds and $350-$900 per hectare of catchment area for off-site ponds. Catchment sizes have not been reported. All data are indicated here in 1984 Canadian dollars, exclusive of land costs.

One site in North York and three in Etobicoke have been investigated as potential locations for stormwater detention ponds (TAWMS TR#9, 1986). All four sites are feasible. Estimated cost for construction of the ponds, exclusive of land costs, range between $654-$3,186 per hectare (Table 1) and are within the range of the reported Ontario and U.S. costs. Estimated total costs for the four ponds is $3.3 million.

2.4 Operating and Maintenance Costs

Little information is available on operating and maintenance costs for ponds. Annual costs in 1984 dollars would appear to range between $2,300-$7,500 per hectare of pond area (Chin, 1985). Conditions vary and include grass cutting, sediment removal, growth control of aquatic plants and in the case of the higher cost includes chemical treatment. Theil (TAWMS TR#9, 1986) provided estimates of annual operating and maintenance costs in the range of $1733 to $2052 per hectare. An average cost of $1900 per hectare of pond area was used, total annual cost is estimated to be $40,192 for operating and maintenance of the four ponds (Table 2).

3.0 Summary/Recommendations

Stormwater detention ponds for quality control, based on the limited available studies, can be 80-90% effective in reducing sediment loads if properly designed. Although no information was found on the control of spills, it is this author's opinion that the design

of an appropriate baffle near the pond inlet could be used for control of imiscible liquids (e.g. oils).

Four sites have been short-listed and studied; three in Etobicoke and one in North York (TAWMS, 1986). All four sites were found feasible. Total catchment area is 2,164 hectares of which 60% is industrial land use.

Estimated total capital cost is $3.3 million, exclusive of land cost. Pond costs range between $654 and $3,186 per hectare of catchment area. Annual operating and maintenance costs range between $1733 and $2052.

Since little information on firm pond design criteria and effectiveness is available, it is recommended that the ponds be constructed in stages as pilot projects. Staging would allow pond effectiveness to be evaluated and design modifications to be incorporated in later-constructed ponds.

Priority of pond construction, based on least unit cost and industrial area controlled, should be given to the following locations in the order of their listing:

1) Etobicoke - Islington and Saskatoon ($425,000)
2) North York - St. Lucie and Storer ($1,184,000)

These two ponds account for about 75% (980 ha) of the total industrial area for 50% of the total cost. Consideration of the remaining two ponds which have considerably higher unit costs should await construction and evaluation of the two priority ponds.

TABLE 1: Estimated Capital Cost for Stormwater Detention Ponds
(Exclusive of Land Costs)

POND LOCATION	CATCHMENT AREA (hectares)	INDUSTRIAL AREA (hectares)	TOTAL ESTIMATED COST	COST PER HA OF CATCHMENT AREA	COST PER HA OF INDUSTRIAL AREA
NORTH YORK					
- St. Lucie & Storer	770	650	$1,184,000	$1,538	$1,821
ETOBICOKE					
- Martingrove & West Humber	264	168	$841,000	$3,186	$5,012
- Albion & Norfield	480	160	$795,000	$1,590	$4,969
- Islington & Saskatoon	650	330	$425,000	$654	$1,288
TOTAL	2,164	1,308	$3,245,000		

Source: TAWMS TR#9, 1986.

TABLE 2: Estimated Operating and Maintenance Cost for Stormwater Detention Ponds

POND LOCATION	ESTIMATED POND AREA (hectares)	ESTIMATED O & M COSTS PER HECTARE OF POND	TOTAL ANNUAL COST
NORTH YORK			
- St. Lucie & Storer	7.7	$1,733	$13,343
ETOBICOKE			
- Martingrove & West Humber	2.64	$1,963	$ 5,183
- Albion & Norfield	4.8	$2,052	$ 9,850
- Islington & Saskatoon	6.5	$1,818	$11,816
TOTAL	21.64		$40,192

Source: TAWMS TR#9, 1986

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TAWMS CONTROL OPTION #12

Title:

Hazardous contaminants (HC) spills management program.

Description of Option:

The development of programs and contingency plans for accidental spills of HC from industrial, commercial and domestic land use areas. (Alternatively use it for industrial areas only or along transportation corridors at sensitive locations, e.g. near streams or lake.)

Effect:

Water Quality:

1. What parameters controlled?
   129 priority pollutants, however, not all are likely to be found for a given area and not likely to be in pure form.
2. What source does it apply to?
   Storm, sanitary, combined sewers, CSO.
3. What problem in the environment is controlled and where?
   Accidental spills from land use activities that impair aquatic life and water uses (recreation, drinking water, public health), to be controlled at or near the source.

Flood Control:

Not applicable.

Treatment Costs:

Not likely to be affected.

Economics:

1. Capital costs.
   May be significant if large holding tanks required.
2. Operating costs.
   Minimal for cleanup after spills.

Implementability and Social Impacts:

1. Likely implementor.
   Provincial government, municipalities, industries.
2. Impact on local residents.
   Possible inconveniences.
3. Jurisdictional conflicts.
   Possible difficulties if HC should enter the sewer or overland drainage systems. Chemical transport conflicts.

Evaluation Methodology:

Review of existing programs with Waste Management Branch and spill contingency office.

Summary of Findings/Recommendations:

Frequency of spills range from 0 spills/year to 6 spills/week. Only spills classified as intermediate and major are reported to MOE. Statistics generated from the data compiled by MOE on intermediate and major spills for the period 1979 - mid-1984 show that:

(a) There were 46 spills in the Humber River basin (very crude estimate, MOE data not explicit enough).
(b) The majority of spills were from industrial sources. Other spills were from:
    -transportation corridors
    -gas stations
    -residential oil spills

All the municipalities surveyed have contingency plans for spills of oil and other hazardous substances. Municipalities were queried for their spills contingency plans. Summaries of the municipalities' responses are contained in the detailed report to follow. Copies of the spill contingency plans from the Region of Peel and the City of Scarborough have been requested. It is the writer's opinion that of all the municipalities surveyed, these two municipalities have the best contingency plans for the spills of oil and other hazardous substances and should be adopted by all municipalities.
Furthermore, it is recommended that each municipality should keep a detailed log of all the spills in their area. For more details, refer to the detailed report to follow.

TORONTO AREA WATERSHED MANAGEMENT STRATEGY STUDY

CONTROL OPTION #12

HAZARDOUS CONTAMINANTS SPILLS MANAGEMENT PROGRAM

June, 1985

Prepared by:

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Introduction

In order to assess and make recommendations to existing programs and contingency plans for accidental spills of hazardous contaminants from industrial, commercial and domestic land use areas, a survey was carried out of all the municipalities in the Toronto area to see how each responded to spills complaints. A summary of each municipality's response is appended.

Summary of Findings/Recommendations:

Frequency of spills range from 0 spills/year to 6 spills/week. All the municipalities surveyed have contingency plans for spills of oil and other hazardous substances. Only spills classified as intermediate and major are reported to MOE (major spill - toxic substance possibly entering a watercourse, minor spill -- gasoline from ruptured fuel tanks of cars). Statistics generated from the data compiled by MOE on intermediate and major spills for the period 1979 to mid-1984 show that:

(a) There were 46 spills in the Humber River basin (very crude estimate, MOE data not explicit enough).
(b) The majority of spills were from industrial sources. Other spills were from:
    -transportation corridors
    -gas stations
    -residential oil spills

The following is a general summary of the contingency plan for most municipalities:

Municipalities receive complaints through the fire department, the police department or the public. When calls are received, they are investigated to see if they are legitimate spills. If they are, the investigator first attempts to locate the source. In cases of car accidents involving ruptured fuel tanks and oil, efforts are made to contain the spill on the surface using sand. If the fire chief deems it unhealthy or unsafe, he could order it to be flushed down the sewer. In other cases, involving chemical spills, gas stations, fuel oil, etc., if the polluters are known, they are given the option to clean-up using their own resources and under the supervision of the municipality involved. When the source of the pollution is not known and if it is minor, municipalities assume the responsibility for the containment, clean-up and restoration of the area. If the municipalities cannot handle the spills by themselves, then they would call in Metro Works. If a spill has reached a watercourse or if the spill is classified as major, MOE is contacted.

In Scarborough, nothing is flushed down the sewers until the substances have first been identified as non-toxic. If the substance has reached the sanitary sewers, Scarborough notifies the Water Pollution Control Plant. Scarborough also does on site tests using a Hach kit (water quality field test kit).

Peel Region have their own spills control trailer. They maintain a computer file with all the industries in the region and what products they manufacture. They follow up whatever information is available to determine the nature of a spill if not obvious. They contact shippers or check truck drivers manifests.

Charges are not usually laid in Peel Region. They recover the cost of clean-up by sending the polluter a bill or by adding it onto their taxes if they are within the region. If the polluter is outside the region and the costs are refused, court action is initiated.

Copies of Peel Region's and Scarborough's spills contingency plans have been requested. It is the writer's opinion that of all the municipalities surveyed, these two municipalities have the best contingency plans for the spills of oil and other hazardous substances and should be adopted by all municipalities.

In order to generate statistics on spills on a per area basis and to better develop programs for them, it is necessary to have detailed records of all spills. This information is difficult to acquire for most municipalities. It is therefore recommended that each municipality should keep a detailed log (ideally computerized) of all spills in their area.

HAZARDOUS CONTAMINANTS SPILLS MANAGEMENT PROGRAM
SURVEY QUESTIONNAIRE

MUNICIPALITY: Peel Region: Joe Monteith - referred to Joe Moore 791-9400

FREQUENCY:

Year	Total No. of Complaints
1982	156 (64 of which were spills)
1983	194 (81 of which were spills)
1984	128 (54 of which were spills)
1985	40 (19 of which were spills)

ACTION TAKEN:

Called out by the fire department, police or the public. Calls are investigated; if legitimate, Waste and Water Pollution Control (WWPC) staff respond to incident. If minor, WWPC will assume responsibility for the containment, clean-up, disposal and restoration. If moderate or major, MOE is called in with assistance from WWPC staff. If polluter is known, he is given the option to clean up under the supervision of WWPC staff. Charges are not usually laid but if the polluter is known, the cost for clean-up is recovered . If costs are refused and the polluter is within the boundary of the region, the costs are added to his taxes; if the polluter is outside of the region, and the costs are refused, the costs are reclaimed through the small claims court.

TYPE OF SPILL/SOURCE

Petroleum products, chemicals, pesticides, resins, transformer oil - non-PCB, excavated drums of buried materials, fuel oil.

PARAMETERS ANALYSED FOR: N/A

NOTES:

1) Two sources of labour:
   a) WWPC works crew
   b) Outside contractors
2) Maintains spill control trailer
3) WWPC has own lab facilities but can sometimes use outside labs.
4) Follow-up with whatever information is available to determine nature of spill if not obvious, e.g. overturned truck - driver's manifest is checked or the shipper is called up. If fish kill, samples are taken. Usually there are indicators of who and what are responsible. WWPC maintain a computer file of all the industries in the region and the products they manufacture.

HAZARDOUS CONTAMINANTS SPILLS MANAGEMENT PROGRAM
SURVEY QUESTIONNAIRE

MUNICIPALITY: Metro Works - Bob Pickett, 947-8847

FREQUENCY: 3-6 spills per week

ACTION TAKEN:

Investigate calls and try to trace origin. If offender has not started clean-up operations, Metro Works does the clean-up. Try to identify substances on the basis of smell, colour, base or from a knowledge of the origin. Charges are laid on a case-by-case basis. Fines for 1984 totalled $87,000, approximately 100 charges.

TYPE OF SPILL/SOURCE

Oil, dye release substances, spills on roadways, illegal dumps in catch-basins.

PARAMETERS ANALYSED FOR: N/A

NOTES:

1) Equipment includes: gas chromatograph, atomic absorption, ultra-violet, infra-red, spectrophotometer.
2) Can detect differences between mineral and vegetable oils; can give qualitative analysis only, not quantitative.
3) Spill statistics for municipalities having combined sewers (City of York, City of Toronto), may be underrated; spills are diverted through the interceptor to the WPCP rather than to a watercourse, thus not detected if not identified at source.

HAZARDOUS CONTAMINANTS SPILLS MANAGEMENT PROGRAM
SURVEY QUESTIONNAIRE

MUNICIPALITY: City of Scarborough - Collin Jamieson, 296-7357

FREQUENCY: Minor spills - 2 per week, major spills - 2 per month

ACTION TAKEN:

Fire department calls Scarborough Works. Scarborough identifies substance. If the substance is non-toxic and cannot be mopped up, decision is made whether to flush it down the sewer or not. If the substance has reached the sanitary sewers, Scarborough calls in Metro Works and notifies treatment plants. If the source is a gas station or pipeline, the appropriate oil company is called in to carry out the cleanup under the supervision of Scarborough.

TYPE OF SPILL/SOURCE

Gasoline, oil products and chemicals (acetate glues, leaky transformer (non-PCB))

PARAMETERS ANALYSED FOR:

Note: an attempt is first made at the site to identify the substance using a Hach kit. If this fails, the sample is taken to Metro Works. Samples are analysed for phenols, resins, hydrocarbons, tri-chlorobenzenes, acetone, etc.

HAZARDOUS CONTAMINANTS SPILLS MANAGEMENT PROGRAM
SURVEY QUESTIONNAIRE

MUNICIPALITY: City of Toronto - Chris Skrok, 947-7706

Frequency: 3 spills per week - mostly car accidents

ACTION TAKEN:

If a spill is on the road surface, the fire department is called in. Sand is used to mop up or sometimes water is used to flush gasoline down the sewer or attempts are made to pump the spill material(oil, etc). If the substance enters a water course, MOE and Metro Works are called in. As always, attempts are made to identify the source. Samples taken by the City or Metro Works or MOE, depending on who gets there first. If the source cannot be easily identified, the drainage areas are provided to Metro Works, who can then look up sewer maps to pinpoint the industry that has likely caused the spill. This information gives Metro Works some indication of the nature of the substance that went down the sewer or is in the watercourse.

TYPE OF SPILL/SOURCE

Gasoline, oil products, and one incident of oil, from a reactor, that was dumped down the sewer in the Junction Triangle.

PARAMETERS ANALYSED FOR: N/A

NOTES: The City has a routine sampling program to monitor man-holes near industries. Samples could be taken once/year or in the case of Junction Triangle, once every two weeks.

HAZARDOUS CONTAMINANTS SPILLS MANAGEMENT PROGRAM
SURVEY QUESTIONNAIRE

MUNICIPALITY: City of North York - Mr. Mario Crognale, 224-6227

FREQUENCY: Last 2-3 years, once per year. Recently, within the last 6-7 months, appears to be 1 spill per week.

ACTION TAKEN:

If minor spill, City of North York deals with the problem. Attempts are made to trace the source; if major, Metro Works takes over, assisted by the City of North York. Minor spills are contained above the ground and pumped out. If the spill has reached the main sewer lines or a water course, samples are taken and analysed by Metro Works. Metro Works does the prosecution and these are handled on a case-by-case basis

TYPE OF SPILL/SOURCE

Oil, gasoline, paint. Varies from 1 gallon castor oil to 6750 litres of heating fuel oil.

PARAMETERS ANALYSED FOR: N/A

HAZARDOUS CONTAMINANTS SPILLS MANAGEMENT PROGRAM
SURVEY QUESTIONNAIRE

MUNICIPALITY: City of Etobicoke - Sing Lau, 626-4552, referred to Rob Taverner, 626-4202.

FREQUENCY: 1-2 spills per month

ACTION TAKEN:

Metro Works would be called in to assist. Attempts are made to trace the source. If the source is located, the polluter would be given the option to clean up with the City's help. If not, the City and Metro Works would contain the spill. If the spill has reached a water course, MOE would be called in. If samples are taken, they would be analysed by Metro Works or in the case of a pollutant reaching a water course, MOE would do the sampling. Prosecutions are done by Metro Works.

TYPE OF SPILL/SOURCE

Glucose (450 litres), gasoline (1 spill of 83,000 litres), oil, fuel oil.

PARAMETERS ANALYSED FOR: N/A

HAZARDOUS CONTAMINANTS SPILLS MANAGEMENT PROGRAM
SURVEY QUESTIONNAIRE

MUNICIPALITY: City of York - Mr. Chi Ng, 653-8700

FREQUENCY: No spills reported to date

PROPOSED ACTION: Dispatch to call duty foreman to confirm spill and location. The duty foreman would then call Metro Works for assistance after nature of spill is confirmed.

TYPE OF SPILL/SOURCE N/A

PARAMETERS ANALYSED FOR: N/A

COMMENTS: This municipality is served by combined sewers, therefore, identification of spills through visual detection in receiving waterbody is difficult (spill would be drained through interceptor to the Humber WPCP).

TAWMS CONTROL OPTION #13

Title:

Temporary/permanent snow disposal facilities

Description of Option:

Improper siting/operation/maintenance of snow disposal facilities can lead to sediment and pollutant loadings to a watercourse. Review the performance of existing snow disposal facilities in the Humber River urban watershed.

Effect:

Water Quality:

1. What parameters controlled?
   Dissolved salts, notably chlorides; heavy metals such as lead; and particulate matter such as clay and sand.
2. What source does it apply to?
   Spring runoff, wet events in urban and suburban areas.
3. What problem in the environment is controlled and where?
   Pollutant loadings to rivers and lakes during spring runoff.

Flood Control:

None.

Treatment Costs:

None

Economics:

1. Capital costs.
   Low - construction/maintenance of berms for site separation from adjacent watercourse.
2. Operating costs.
   Medium - removal and disposal of contaminated layer of soil from the site after snow is gone.

Implementability and Social Impacts:

1. Likely implementor.
   Local municipality and MTC.
2. Impact on local residents.
   None if located as prescribed by MOE Guidelines, i.e. well away from residential areas.
3. Jurisdictional conflicts.
   None.

Evaluation Methodology:

Moderate level qualitative evaluation. Review of performance of MOE Guidelines for Snow Disposal Facilities. Identify active sites in the Humber River urban watershed through contact with

municipalities and agencies involved in snow removal, and compile details of site size, truckload capacity, and site contents. Carry out field site inspection and verify adherence to MOE Guidelines. Initiate a water quality monitoring program in order to characterize water quality condition of the disposal site meltwater and the impact on the receiving stream.

Summary of Findings/Recommendations:

- Guidelines to minimize the environmental impact of snow collection and disposal practices are set out in the MOE Policy Manual as "Guidelines for Snow Disposal and Deicing Operations in Ontario, 1984", (MOE, 1984). Snow is to be disposed on properly selected land sites evaluated by the following criteria: accessibility; noise; alternative use of site; visual considerations; surface and subsurface drainage; previous use of site; stability of soils; and public safety.

- During the Winter of 1984-85 three Snow Disposal Sites were operated in the Humber River urban watershed;

    1. Symes Road Dump, City of Toronto, capacity of 3,500 truckloads, contents on March 15/85 was 3,540 truckloads.
    2. Black Creek Dump, City of York, capacity of 10,000 truckloads, contents on March 15/85 was 8,000 truckloads.
    3. Eglinton Flats Reserve Dump, Metro Toronto, capacity 600 truckloads, contents on March 15/85 was 600 truckloads.

- All three sites were found to be in compliance with the MOE guidelines.

- Water quality monitoring at the Black Creek Dump Site on 7 occasions over the period April 1 to June 11, 1985, shows no appreciable difference between the quality of the snow dump meltwater and the receiving water, Black Creek, and hence the impact is minimal.

- For more details, refer to detailed control option report to follow.

TORONTO AREA WATERSHED MANAGEMENT STUDY

CONTROL OPTION #13

TEMPORARY/PERMANENT SNOW DISPOSAL FACILITIES

September 1985

Prepared by

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Ministry of the Environment

1. Introduction

Snow removed from municipal roadways to land disposal sites has the potential to contain accumulated contaminants such as oxygen demanding organic material; dissolved salts, notably chlorides; heavy metals such as lead; particulate matter such as clay, silt and sand; and, street litter and often domestic garbage.
During the early spring of 1985, the River Systems Assessment Unit of the Water Resources Branch, undertook a survey to identify the location, size and contents of active Snow Disposal Facilities in the urban portion of the Humber River watershed. The survey included a field site assessment at all locations to verify adherence to MOE guidelines for Snow Disposal Facilities and a limited water quality monitoring program at one site. The monitoring program involved sampling of the disposal site meltwater and the adjacent watercourse above and below the site, in order to characterize water quality conditions of both the point source and the receiving water. The purpose of this report is to document the results of the survey.

2.0 Method/Results

2.1 MOE Guidelines for Snow Disposal

Guidelines to minimize the environmental impact of snow collection and disposal practices are set out in the MOE Policy Manual as "Guidelines for Snow Disposal and De-icing Operations in Ontario 1984". The guidelines prescribe the disposal of snow on land as the preferable method of handling this waste. Under conditions where direct disposal of snow to a watercourse is the only available alternative, approval is required from the Regional Manager, Technical Support, Ministry of the Environment prior to commencement of such an operation.

In the selection of land disposal sites, a number of criteria are prescribed by the Guidelines to evaluate the relative suitability of sites. They are:

1. Accessibility - areas selected should have suitable access for heavy truck traffic.
2. Noise - sites should be located so that the noise of hauling, dumping and piling will not annoy nearby residents.
3. Alternative and Future Use of Site - because of contaminant loadings to the soil, the use of the site for other purposes is restricted unless remedial measures are taken.
4. Visual - melting snow piles are usually unsightly and should be located away form the public eye.
5. Drainage - with respect to surface drainage, the site should be separated from an adjacent watercourse by diking or, in flat areas a separation of 600 feet. The natural drainage pattern should not be obstructed.
   For sub-surface drainage, consideration should be given to possible contamination of the groundwater aquifer.

Snow disposal sites in the Humber River basin are under the jurisdiction of the Abatement Section, Central Region Office, Ministry of the Environment. Enquiries with Central Region indicated that the Abatement Section staff performed formal approvals for Snow Disposal Sites until the late 1970's. In more recent years they have continued to review site requests, but as a result of staffing limitations, there is currently no formal site approval mechanism or follow-up inspection of field sites. However, all agencies operating Snow Disposal Sites within Metropolitan Toronto are aware of, and operate within, the MOE Guidelines.

2.2 Snow Disposal Activities - Winter of 1985

Snow Disposal Sites, active in the winter of 1985 within Metropolitan Toronto, were identified from correspondence on file with Technical Support Section of MOE Central Region received from the following municipalities and agencies; - Metro Toronto, City of Toronto, City of Etobicoke, City of York, City of North York, City of Scarborough and Central Region of the Ministry of Transportation and Communications. Four snow disposal sites were found to be located within the urban portion of the Humber River watershed. The operating municipalities - City of Toronto, City of York, and Metro Toronto, were contacted for details of site size, truckload capacity, and number of truckloads in the site for the winter of 1985.

Figure 1 shows the location of these disposal sites, while Table 1 provides details for each location. Sites 1 and 2 are main disposal locations operated by the Department of Works of the City of Toronto (west side) and City of York respectively. Site 2a, is a small reserve site used only occasionally by the City of York. Site 3 is a reserve disposal site used in winters of heavy snowfall, and is operated by The Municipality of Metropolitan Toronto Department of Roads and Traffic.

TABLE 1: 1985 SNOW DISPOSAL SITES IN THE HUMBER RIVER BASIN

Site No.	Site Name	Location	Operating Agency	Available Area (ha)	Capacity in Truck Loads
1	Symes Road	Weston Rd & St Clair W (Keelesdale Park)	City of Toronto	0.81	3500
2	Black Creek	Eglinton Ave & Black Cr Dr.	City of York	2.0	10,000
2a	Wilby Dump	Lawrence Ave & Weston Rd	City of York	small	700
3	Eglinton Flats	Eglinton Ave W at Humber R.	Metro Toronto	1 (reserve site only)	600

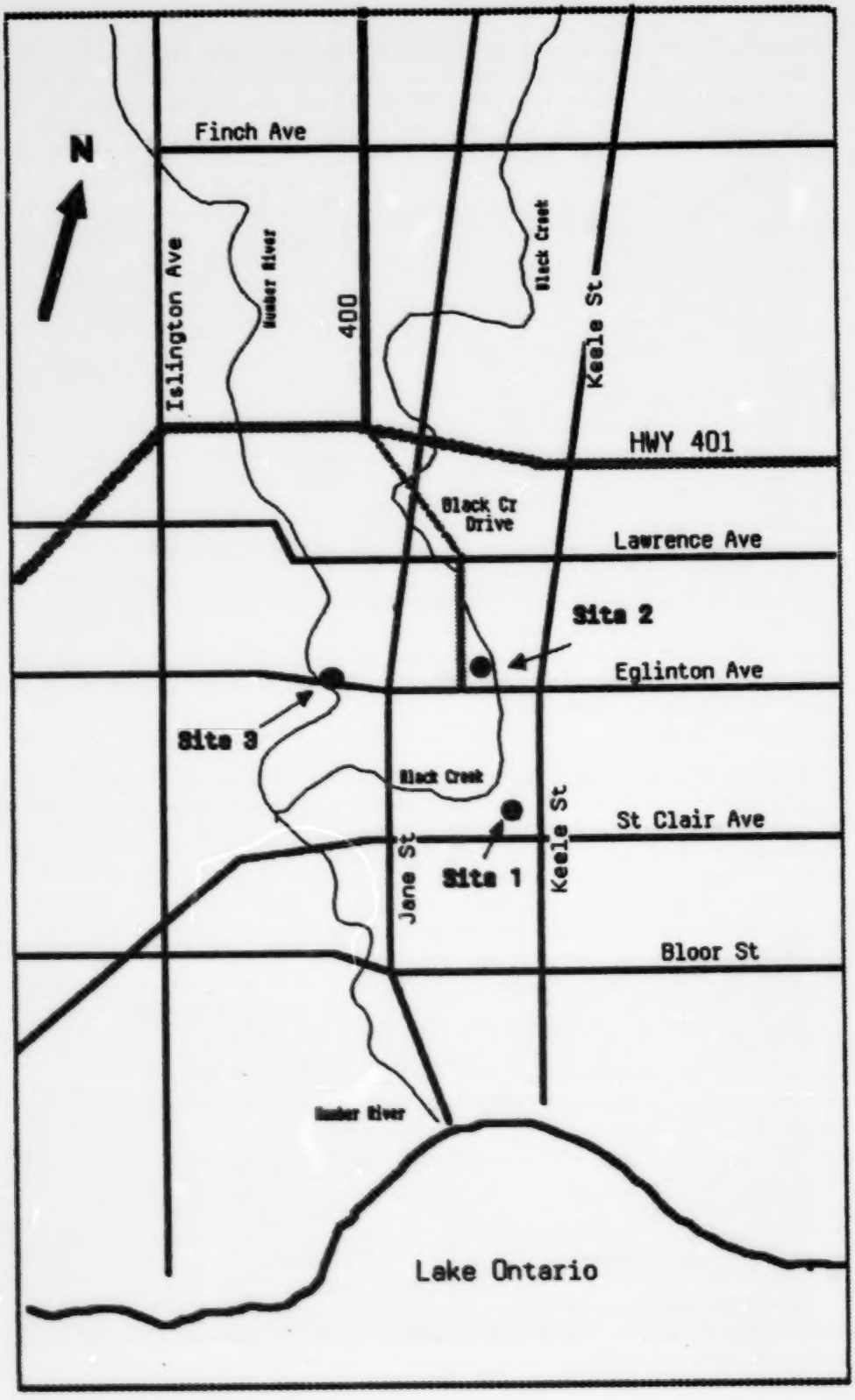

FIGURE 1: LOCATION OF SNOW DISPOSAL SITES IN THE HUMBER RIVER BASIN – WINTER 1985.

Snowfall for the months of January, February and March 1985, measured at Pearson International Airport, totaled 125.6 cm or 153% of the station normal (1951-1980) of 82.3 cm. Snow accumulation during the winter of 1985 was well above normal, and the snow disposal facilities were either, at or near, capacity by mid March 1985.

2.3 Field Observations

A field site inspection of the 3 major snow disposal sites in the Humber basin was made on March 13, 1985. All sites were found to be in general compliance with the Ministry's criteria with respect to location and site operations, although snow disposed at Site 3 was not properly separated from the adjacent watercourse.

Site 1, the Symes Road Site operated by the City of Toronto, and shown in Photos on Plate 1, is located on the Ontario Hydro transmission line property to the north of the industrial area at northwest corner of St Clair Ave West and Weston Rd. A small open watercourse which is tributary to Black Creek flows beside the transmission line on the south side. Snow is dumped beneath the line on a strip approximately 500 meters long, and the height to which the snow can be piled is limited by a required vertical separation from the overhead wires. The snow disposal site is separated from the adjacent watercourse by a berm of rock and earth. On the day of visit the site was full containing 3540 truckloads of snow, and was closed to further dumping.

Site 2, Black Creek Site operated by the City of York and shown in the photos on Plate 2, is located in a reserved area at the north end of Keelesdale Park at the northeast corner of Eglinton Ave and Black Creek Drive. This site is a major disposal facility with an approximate capacity of 10,000 truckloads. Black Creek is immediately adjacent to the northeast side of the site, and the site is separated from the stream by a large grassed berm along the north and east sides. Snow brought to the site is pushed into a high pile using a bulldozer. On the date of visit the site contained some 8,000 truckloads, a virtual mountain of snow. Although large, the site appears to be well operated and maintained.

Site 3, Eglinton Flats Site operated by Metropolitan Toronto and shown in photos on Plate 3, is located on the Humber River flood plain beneath the elevated roadway at Eglinton Ave West and the Humber River. On the day of visit snow was observed piled right to the edge of the Humber River with no separation from the watercourse. This clearly contravenes the Guidelines, however the site is small and this is a secondary dump used only in years of heavy snowfall. No direct melt to the river was observed, however, a larger separation between the rivers edge and the snow pile should be adhered to. In early March 1985 the site contained about 600 truckloads of snow.

March 13, 1985. View looking West at snow disposal site beneath the Ontario Hydro transmission line.

March 13, 1985. Earthen berm at mid photo separates the snow pile on the right from the adjacent watercoarse.

PLATE 1: Symes Road Snow Dump - operated by the City of Toronto, Department of Works.

March 13, 1985. View looking south with Black Creek on the left. Note the grassed berm which separates the snow pile from Black Creek.

April 25, 1985. Same view as above with approximately one half of the snow pile melted away.

PLATE 2: Black Creek Snow Dump - operated by the city of York, Department of Works.

March 13, 1985. View looking east to the snow disposal site located on the Humber River flood plain beneath Eglinton Ave. Note that the snow pile is not properly separated from the adjacent river.

April 25, 1985. Same view as above with the snow melt nearly complete.

PLATE 3: Eglinton Flats Snow Dump - secondary disposal site operated by Metro Toronto Roads & Traffic Dept.

2.4 Water Quality Sampling Program

The Black Creek Snow Disposal Site was selected for a limited water quality monitoring program. Sampling points were established on Black Creek immediately above and below the snow disposal site, and at the point where the snow disposal site meltwater discharged to Black Creek.

Methods employed for sample collection were consistent with the Ministry's protocol for sample submission, see "A Guide to the Collection and Submission of Samples for Laboratory Analysis" . Three distinct sample containers were filled at each site at the time of sampling. Samples were analysed for three test groups: - conventional water quality, microbiological, and inorganic trace contaminants. Individual tests within each group are shown in Table 2.

TABLE 2: WATER QUALITY ANALYSIS TEST GROUPS

Group 1 Conventional Water Quality

- Calcium
- Sodium
- Chloride
- Residue Filtrate
- Residue Particulate
- Total Phosphorus
- Phosphate
- Ammonium
- Dissolved Organic Carbon

Group 2 Microbiological Tests

- Fecal Coliform
- Escherichia Coli
- Fecal Streptococcus
- Pseudomonas Aeruginosa

Group 3 Inorganic Trace Contaminants

- Manganese
- Arsenic
- Cadmium
- Chromium
- Nickel
- Lead
- Zinc

Samples were collected at weekly intervals during the month of April, and at 2 week intervals during May and early June. In total samples for seven sampling dates were submitted for analysis.

2.5 Analytical Results

The analytical results for each sampling site are presented in Tables A1, A2, A3 of Attachment A. The four samples taken during April were erroneously directed to the Ministry's Sewage Analysis Laboratory, rather than the Rivers and Lakes Laboratory. Detection limits are much higher in the Sewage Laboratory, and thus the analysis results for the April samples are less meaningful than those samples for May and June which were processed in the Rivers Laboratory.

The arithmetic & geometric means of all results, regardless of which lab processed the sample, are presented for comparison of test results from the three sites. On the basis of comparison of the geometric means in Tables A1, A2, & A3, there is no appreciable difference in the quality of the meltwater leaving the Black Creek Snow Dump and that of Black Creek. It can also be seen that there is no major degradation of the water quality in Black Creek below the site, due to the meltwater.

A summary of the analysis results for the Snow Dump meltwater is provided in Table 3. For each parameter, the concentration ranges, (ie maximum and minimum) are summarized together with the geometric mean concentration and the number of samples used in the computation of the mean. Where applicable, the data is compared to the Provincial Water Quality Objective (PWQO) and the number of samples exceeding the objective is given.

In the snow dump meltwater, all sample results for cadmium, and copper were in excess of the PWQO, while levels of nickel, lead, and zinc exceeded the PWQO on only two or three of the seven sample dates. The geometric mean for fecal coliforms is only slightly in excess of the objective, and from the data in Table A3 it can be seen that coliform counts did not rise until June when temperatures were warmer.

3. Summary/Recommendations

Guidelines to minimize the environmental impact of snow collection and disposal practices are set out in the MOE Policy Manual as "Guidelines for Snow Disposal and Deicing Operations in Ontario, 1984", (MOE, 1984). Snow is to be disposed on properly selected land sites evaluated by the following criteria: accessibility; noise; alternative and future use of site; visual considerations; surface and subsurface drainage; stability of soils; and public safety.

TABLE 3: BLACK CREEK SNOW DISPOSAL SITE MELTWATER

WATER QUALITY DATA

	PARAMETERS							
	RSP (mg/L)	RSF (mg/L)	T.PHOS (mg/L) as P	FRP (mg/L) as P	AMMON (mg/L) as N	DOC (mg/L) as C	MANGN (mg/L) as Mn	CHLORIDE (mg/L) as Cl
MAX	86.8	900	.150	.074	.20	3.2	.830	309.
MIN	9.94	210	.047	.010	.050	2.0	.088	7.76
GEOMETRIC MEAN	25.1	384	.085	.022	.089	2.5	.170	41.6
# SAMPLES	7	7	6	7	7	7	7	7
PWQO	-	-	.003	—	—	-	—	-
# SAMPLES ABOVE PWQO	-	-	6	-	-	-	--	-

MICROBIOLOGICAL DATA

	PARAMETERS				
	FECAL COLIFORM C/100ml	E. COLI C/100ml	FECAL STREP C/100ml	PSEUD AERUGINOSA C/100ml	BKGD PSEUD AERUGINOSA C/100ml:
MAX	5500	2300	8100	100	270
MIN	20<	20<	20<	4<	4<
GEOMETRIC MEAN	127	172	89	15	17.1
# SAMPLES	7	6	7	7	7
PWQO	100	-	-	-	-
# SAMPLES ABOVE PWQO	3	-	-	-	-

INORGANIC TRACE CONTAMINENT DATA

	PARAMETERS								
	CALCIUM (mg/L) as Ca	SODIUM (mg/L) as Na	ARSENIC (mg/L) as As	CADMIUM (mg/L) as Cd	CHROMIUM (mg/L) as Cr	COPPER (mg/L) as Cu	NICKEL (mg/L) as Ni	LEAD (mg/L) as Pb	ZINC (mg/L) as Zn
MAX	106	139	.03	.012	.03	.019	.062	.096	.087
MIN	34.3	6.10	.001	.0003	.003	.007	.002	.023	.020
GEOM. MEAN	61.9	20.2	.007	.0009	.010	.012	.007	.037	.029
# SAMP.	6	5	7	7	7	7	7	7	7
PWQO	-	-	.100	.0002	.100	.005	.025	.025	.030
# SAMPLES ABOVE PWQO	-	-	0	7	0	7	1	3	2

During the Winter of 1984-85 three Snow disposal sites were operating in the Humber River urban watershed;

1. Symes Road Dump, operated by the City of Toronto, on Ontario Hydro transmission line property, with a dump capacity of 3,500 truckloads. This dump contained 3,540 truckloads of snow on March 15 1985.

2. Black Creek Dump, operated by the City of York, with a capacity of 10,000 truckloads. This dump contained 8,000 truckloads of snow on March 15, 1985.

3. Eglinton Flats Reserve Dump, operated by Metropolitan Toronto, with a capacity of 600 truckloads. This reserve dump contained approximately 600 truckloads of snow on March 15, 1985.

All sites were found to be located and operated in general compliance with the MOE Guidelines for snow disposal sites. At the Eglinton Flats Reseve Dump however, the disposed snow was not properly separated from the Humber River by either a berm or 600 foot buffer zone. This should be corrected if use of this reserve site is to be continued.

Water Quality Monitoring at the Black Creek Dump site on 7 dates over the period April 1 to June 11, 1985, shows no appreciable difference between the quality of the snow dump meltwater and the receiving water, Black Creek, and hence the impact on Black Creek water quality is likely minimal.

References

1. MOE, "Guidelines for Snow Disposal and Deicing Operations in Ontario, 1984", Ontario Ministry of the Environment, 1984.

2. MOE, " A Guide to Collection and Submission of Samples for Laboratory Analysis, 1979", Ontario Ministry of the Environment, 1979.

ATTACHMENT A

SNOW MELTWATER AND RIVER WATER QUALITY DATA

AT BLACK CREEK SNOW DISPOSAL SITE

TABLE A1: BLACK CREEK SNOW DISPOSAL SITE SURVEY
CONVENTIONAL WATER QUALITY DATA

SAMPLE DATE YRMNDY	RSP (mg/L)	RSF (mg/L)	T.PHOS (mg/L) as P	FRP (mg/L) as P	AMMON (mg/L) as N	DOC (mg/L) as C	MANGN (mg/L) as Mn	CHLORIDE (mg/L) as Cl
	PARAMETERS							
Black Creek Above the Snow Dump								
850401	90.8	656.	.200	.01<W	.20<T	5.1	3.32	73.6
850410	10.3	1190.	.120	.40	.40	2.8	0.245	373.4
850418	8.8	1010.	.100<T	.02<T	.30	4.4	0.155	326.4
850425	6.5	1090.	.080<T	.04<T	.10<T	3.1	0.152	320.0
850506	5.30	802.	.076	.019	.450	5.3	0.133	231.5
850523	8.46	806.	.053	.010	.790	4.6	0.077	273.1
850611	7.36	886.	.050	.013	.664	3.6	0.091	275.7
ARITH MEAN	19.6	920.	.097<A	.073<A	.415<A	4.1	0.596	267.7
GEOM MEAN	10.9	904.	.087<A	.026<A	.344<A	4.0	0.210	243.0
Black Creek below the Snow Dump								
850401	96.9	654.	.150	.01<W	.10<T	5.1	3.74	202.2
850410	12.8	1170.	—	.40	.70	2.9	0.255	371.2
850418	6.0	1030.	.120	.01<W	.40<T	6.0	0.165	347.2
850425	5.3	1110.	.060<T	.01<W	.05<W	3.2	0.180	320.0
850506	3.04	812.	.044	.019	.580	5.6	0.123	240.7
850523	2.65	880.	.045	.018	.740	5.0	0.076	261.2
850611	8.03	948.	.050	.012	.862	3.5	0.105	286.8
ARITH MEAN	19.2	943.	.078<A	.068<A	.490<A	4.5	0.663	289.9
GEOM MEAN	8.2	928.	.069<A	.021<A	.339<A	4.3	0.223	284.3
Black Creek Snow Dump Meltwater								
850401	14.8	900.	.060<T	.01<W	.20<T	2.6	0.830	309.4
850410	17.7	744.	.060<T	.01<W	.20<T	3.2	0.160	192.6
850418	20.0	396.	---	.01<W	.05<W	2.4	0.132	69.4
850425	86.8	332.	.150	.04<T	.05<W	2.6	0.184	28.4
850506	44.56	274.	.100	.034	.110	2.5	0.128	19.0
850523	9.94	210.	.047	.022	.062	2.4	0.088	12.4
850611	30.91	244.	.135	.074	.064	2.0	0.115	7.76
ARITH MEAN	32.1	443.	.092<A	.029<A	.105<A	2.5	0.234	91.3
GEOM MEAN	25.1	384.	.085<A	.022<A	.089<A	2.5	0.170	41.6

< - Result less than reported value,
<T - Tentative, for information only, <W - Minimum measurable amount,
<A - Test value with remark <T or <W used in computation of mean.

TABLE A2: BLACK CREEK SNOW DISPOSAL SITE SURVEY
MICROBIOLOGICAL DATA

SAMPLE DATE YRMNDY	FECAL COLIFORM C/100ml	E. COLI C/100ml	FECAL STREP C/100ml	PSEUD AERUGINOSA C/100ml	BKGD PSEUD AERUGINOSA C/100ml:
	PARAMETERS				
Black Creek Above the Snow Dump					
850401	4200	2400	1640	20<	20<=>
850410	320	140<=>	280	10<	10<
850418	140<=>	---	180<=>	50<=>	20<=>
850425	1540	1400	200	10<=>	10<=>
850506	1660	1620	180	10<=>	10<=>
850523	880	520	40<=>	212	88
850611	8600	5700	---	210	3300
ARITH MEAN	2477	1963	420	75	494
GEOM MEAN	1200	1150	405	33	38
Black Creek Below the Snow Dump					
850401	3100	1800	1880	20<=>	60<=>
850410	340	320	180<=>	10<=>	10<
850418	149<=>	--	140<=>	10<=>	20<=>
850425	480	440	240	10<	10<=>
850506	1000	940	200	10<=>	10<=>
850523	720	480	240<=>	24	24
850611	5400	3100	---	30<=>	2000
ARITH MEAN	1598	1180	480	16	304
GEOM MEAN	839	841	285	15	35
Black Creek Snow Dump Meltwater					
850401	20<	20<	20<	20<	20<=>
850410	20<	20<	20<	10<	10<
850418	20<	--	20<	10<	10<
850425	160<=>	440	220	10<	10<
850506	1260	1080	160<=>	10<	20<=>
850523	60<=>	60<=>	20<=>	4<	4<
850611	5500	2300.	8100	100	270
ARITH MEAN	1006	653	1223	23	49.1
GEOM MEAN	127	172	89	15	17.1

< - Result less than reported value,
<=> - Approximate result.

TAWMS CONTROL OPTION #14

Title:

Flushing of Combined Sewers

Description of Option:

To flush slow-flowing combined sewers with water from fire hydrants or water tankers periodically to prevent silting, hence reducing the quantity of sewage sediments washed out with combined sewer overflow.

Effect:

Water Quality:

1. What parameters controlled?
   Contaminants in combined sewers.
2. What source does it apply to?
   Combined sewers.
3. What problem in the environment is controlled and where?
   Reduces contaminant loads from combined sewer overflow into receiving waters.

Flood Control:

None

Treatment Costs:

Not significant.

Economics:

1. Capital costs.
   Automatic flushing equipment: approx. $16,000/segment
   Manual flushing (includes tankers): approx. $4550/segment
2. Operating costs.
   Automatic flushing: $2900/segment
   Manual flushing: $3400/segment

Implementability and Social Impacts:

1. Likely implementor.
   Municipality.
2. Impact on local residents.
   None.
3. Jurisdictional conflicts.
   Not expected.

Evaluation Methodology:

Literature review.

Summary of Findings/Recommendations:

- There is a very limited amount of literature available on sewer flushing. Pisano's reports (Pisano, 1976, 1979) were the most comprehensive. They concluded that sewer flushing was effective in removing sediment from local sewers, but, before this can be done, sewer mapping and modelling are needed to better select the sewer segments that are to be flushed.

- Recommend that a pilot project be carried out in a combined sewer area (using Pisano's approach) so that the practice can be better evaluated.

- For the Humber watershed, assume 60 segments to be flushed. The costs are as follows:

	CAPITAL	ANNUAL
Automatic	$960K	$175K
Manual	$275K	$204K

- For more details, refer to detailed control option report to follow.

TORONTO AREA WATERSHED MANAGEMENT STRATEGY STUDY

CONTROL OPTION #14

FLUSHING OF COMBINED SEWERS

June, 1985

Prepared by:

C. Kennedy
TAWMS Project Staff

1. Introduction

Contaminated sediments deposited in a combined sewer during periods of low flow can represent a potential source of contaminant input during combined sewer overflow events. The purpose of this report is to evaluate, through a review of existing literature, the effectiveness of flushing combined sewers as a means of reducing pollutants discharged into receiving waters during overflow events.

2. Discussion of Results

Experiments conducted by Pisano (1976, 1979), in the suburbs of Boston, Massachusetts demonstrated that sewer flushing can be a cost-effective means of controlling CSO pollutant loads in receiving waters from wet weather events. The experiments were divided into four periods of six weeks each (one period per season). In Pisano's (1979) study, four small diameter laterals with high sedimentation rates were used in the experiments (two 305 mm and two 380mm diameter pipes). The sediment from these laterals was flushed into a trunk sewer with sufficient flow to keep the solids in suspension. The deposition rate ranged from 50 kg/day/basin to 90 kg/day/basin.

From these studies Pisano (1979) was able to determine the following organic and nutrient contaminant removal rates:

Manhole to manhole : 75 to 95%

Serial segments less than 210 metres : 65 to 75%

Serial segments greater than 305 metres : 35 to 45%
(The longest segment tested was 370 metres)

These rates were determined for both manual and automatic sewer flushing procedures. Automatic sewer flushing does not require an external water source whereas manual flushing does (water tanker). Automatic sewer flushing involves the installation of an inflatable dam that will quickly release the water trapped behind it.

Sewer flushing every three to four days will keep the sewers free of solids deposition. This will keep the sewers well-maintained. The cost of a sewer flushing program would depend on the flushing method, either automatic or manual. The cost of sewer flushing is for each segment flushed and are presented in Table 1 (Pisano, 1979).

TABLE 1: SEWER FLUSHING COST PER SEGMENT (1978 $U.S.)

METHOD	ANNUAL COST	CAPITAL COST
Automatic	$1,630	$9,000
Manual	$1,930	$2,600

Manual flushing of sewers would require additional manpower over automatic flushing. The trade-off is obviously capital costs versus annual operation and maintenance costs. Overall, there would be only a three to six per cent increase in the operation and maintenance costs (an increase of three to six men).

3. Recommendations

Pisano (1976) recommended that a series of preliminary steps be taken prior to sewer flushing. These steps are necessary in order to accurately predict and control solids deposition within a catchment. The steps are as follows:

1) Detailed mapping of the study catchment(s).
   - hydraulic characteristics of interceptors, trunks and laterals
2) Solids deposition predictions.
   - for single length of pipe
   - daily deposition in a catchment
3) Sewer flushing predictions.
   - predict flushing volumes using only pipe section hydraulic parameters
   - provides a feasibility check on flushing

After the first two steps have been completed the feasibility of sewer flushing can then be assessed.

References

Pisano, W.C., "Cost Effective Approach for Combined and Storm Sewer Cleanup", in Proceedings of Urban Stormwater Management Seminars. WPD-03-76-04, Water Planning Division, U.S. EPA, January, 1976.

Pisano, W.C. et al, "Dry Weather Deposition and Flushing for Combined Sewer Overflow Pollution Control", Office of Research and Development, U.S. EPA, Cinn., Ohio, EPA-600/2-79-133, August, 1979.

TAWMS CONTROL OPTION #15

Title:

Combined sewer overflow (CSO) interception for treatment at the Humber WPCP.

Description of Option:

(a) To intercept combined sewer overflow by detention tanks; or
(b) To reduce overflow by increasing flow to WPCP by resetting overflow regulators; some detention tank capacity still needed.
In both (a) and (b), detained flow to be returned to WPCP.

Effect:

Water Quality:

1. What parameters controlled?
   All parameters generally in combined sewage.
2. What source does it apply to?
   Combined sewers at overflow regulators.
3. What problem in the environment is controlled and where?
   To reduce discharge of untreated combined sewage to Black Creek.

Flood Control:

No, but adjustment of regulators has to be done carefully to avoid aggravation of flooding in upstream sewers.

Treatment Costs:

Increased interception will increase treatment costs.

Economics:

1. Capital costs.
   $4.7M for (a)
   $5.3M for (b)
2. Operating costs.
   Option (a) $31K/ann. to treat returned flow and periodic maintenance of tanks.

Implementability and Social Impacts:

1. Likely implementor.
   Local municipalities, Metro.
2. Impact on local residents.
   Not significant if control was properly built and operated.
3. Jurisdictional conflicts.
   Possible conflict in planned uses of land needed as tank sites. Debate of sharing of costs and capacities of sewers and treatment facilities.

Evaluation Methodology:

Model simulation to obtain CSO reduction statistics for alternative control measures. Examine feasibility and estimate costs of control measures.

Detailed costing:

CSO interception by detention tanks and diversion of detained flow to WPCP. The cost is for two detention tank facilities to eliminate CSO in the City of York against annually recurrent storms.

Capital Cost for 2 detention tanks to provide 51,000 m^3 of storage $4.7 million

Annual Cost

Cleaning of tanks (2)	$15600	
Treating detained flow	$15000	
	$30600	say $31K

Land Cost (provided by MTRCA)

LOCATION	AREA(ha)	TOTAL COST($)	COST/ha($)
Black Creek (E. of Rockcliffe Blvd.)	1.74	12.9K	7.4K
Black Creek (W. of Rockcliffe Blvd.)	1.0	7.5K	7.4K
Black Creek (Hyde Ave.)	0.9	6.6K	7.3K
Humber Marsh (Berry Rd.)	0.4	3K	7.5K

Summary of Findings/Recommendations:

- Estimated CSO statistics for no control in one average season from April to October: frequency 26 events; volume 330,000 cubic metres; SS 63,000 kg; lead 64 kg; zinc 112 kg.
- Possible to completely eliminate overflow in storms of maximum recurrence interval of 2 years by either:
  (a) providing 51,000 cubic metres storage at overflow regulators, or
  (b) increasing combined sewage flow to Humber WPCP by 2 cubic metres per second (i.e. 17% WPCP treatment capacity), and providing 33,000 cubic metres storage at overflow regulators. WPCP capacity not exceeded by this option, but on-site verification of the WPCP capacity necessary.
- Estimated cost $4.7 million for (a) or $5.3 million for (b). Option (b) would increase annual WPCP treatment cost by about 1/2% on top of the cost of treating return flow. All estimated costs exclude land costs.

- Option (a) is preferred to option (b) for better reliability and lower costs.

References:

TAWMS, "Humber Sewershed Combined Sewer Overflow Study", Technical Report #7, Toronto Area Watershed Management Strategy Study, 1986.

TAWMS, "Feasibility Study and Costing of Proposed Pollution Control Measures in Humber Sewershed", Technical Report # 9, Toronto Area Watershed Management Strategy Study, January, 1986.

TAWMS CONTROL OPTION #16

Title:

High-rate treatment of Combined Sewer Overflow (CSO) (disinfection and solids separation)

Description of Option:

On-site high-rate treatment of combined sewage before discharge to receiving water. Solids separation by swirl concentrator; bacteria disinfection by chlorination and dechlorination. Solids removal would improve disinfection efficiency slightly, but is not a pre-requisite.

Effect:

Water Quality:

1. What parameters controlled?
   Solids separation: solids
   Disinfection: bacteria.
2. What source does it apply to?
   Combined sewer overflow.
3. What problem in the environment is controlled and where?
   To reduce solids and bacterial loads of overflow at overflow regulators.
   To reduce discharge of untreated combined sewage to Black Creek.

Flood Control:

None

Treatment Costs:

Moderately high for solids removal.
Low for disinfection.

Economics:

1. Capital costs.
   Solids removal - $2.07 million for 4 overflow locations.
   Disinfection - $441,000 for 4 overflow locations (includes dechlorination).
2. Operating costs.
   Moderate costs for personnel and logistic supports.
   Solids removal - $24,510/year.
   Disinfection - $73,500/year.

Implementability and Social Impacts:

1. Likely implementor.
   Local municipality (City of York) or Metro.
2. Impact on local residents.
   Not significant, but may be perceived as an inadequate solution.
3. Jurisdictional conflicts.
   Debate of cost-sharing and operation. May set a precedent for regulating combined sewer overflow to a receiving water.

Evaluation Methodology:

Literature review of successful applications to cases similar to TAWMS combined sewer area. Estimation of required capacity and costs using literature treatment data and local cost data.

Summary of Findings/Recommendations:

- Swirl regulator/concentrator followed by high-rate chlorination/dechlorination was determined through literature review as the most cost-effective treatment system for SS and bacteria reduction in CSO.

- The swirl regulator/concentrator is capable of removing 52-63% SS. It is not very effective in the removal of fine solids and heavy metals. Its initial capital and annual O&M costs are estimated to be $2.07 million and $24,510 for the four overflow locations in the Black Creek area.

- Depending on the CSO quality, fecal coliforms can be reduced from an initial level of 10 exp 6/100 ml to 100-400/100 ml by using 12 to 40 mg/L chlorine dosage and 2 minutes contact time. End-of-contact residual will range between 5 to 30 mg/L. Chlorine dosage and residual are reduced as contact time increases. Dechlorination using a sulphite or bi-sulphite solution will follow chlorination to remove chlorine residuals. Initial capital and annual operating and maintenance costs for four chlorination-dechlorination locations are $441,000 and $73,500 respectively.

References:

Ho, T., "Literature Review - High Rate Treatment of Combined Sewer Overflows at the Black Creek Catchment", Draft Report, Toronto Area Watershed Management Strategy Study, 1985.

TAWMS CONTROL OPTION #17

Title:

Flow control at local combined sewers (includes inlet restriction and/or storage at inlet).

Description of Option:

To provide underground detention tanks or to restrict inlet flow to sewers; all control works in local networks, principally in combined sewer area.

Effect:

Water Quality:

1. What parameters controlled?
   Pollutants generally in combined sewage.
2. What source does it apply to?
   Local combined sewers.
3. What problem in the environment is controlled and where?
   To reduce/attenuate flow to combined sewers and hence reduce overflow to receiving waters or volume requiring treatment at Humber WPCP.

Flood Control:

Yes, basement flooding mitigation.

Treatment Costs:

Potentially increases volume of flow intercepted for treatment at Humber WPCP.

Economics:

1. Capital costs.
   Substantially higher than end-of-pipe control in main sewers on basis of cost per volume of overflow reduced. Estimated at $16.6M.
2. Operating costs.
   Periodic desilting of tanks and routine maintenance. Estimated at $50k/ann.

Implementability and Social Impacts:

1. Likely implementor.
   Local municipality (City of York).
2. Impact on local residents.
   Inconvenience to road users during construction and maintenance. May aggravate local flooding if control malfunctions.
3. Jurisdictional conflicts.
   Grants for implementation may not be available under existing criteria.

Evaluation Methodology:

Simulate a major combined sewer system in City of York by modelling. Determine locations and capabilities of inlet detention tanks required to eliminate basement flooding in 2, 5 and 10-year design storms. Examine feasibility of control works and estimate costs. Extrapolate results to other combined sewer areas in the City.

Summary of Findings/Recommendations:

- Feasible to eliminate basement flooding up to 10-year storm, by means of about 60 local underground tanks with total capacity of about 26,000 cubic metres.
- With 10-year storm control in place, CSO volume in an average season would be reduced by 10%. No reduction in CSO frequency.
- The capital cost to provide a 10 year level of protection against basement flooding and reduce combined sewer overflow to an average of one event per year is $18.5 M, of which $16.6 M is required for the detention tank and inlet control works, and $1.9 M for the storage facilities adjacent to the existing Black Creek regulators.
- Option recommended if basement flooding control required by TAWMS; not recommended if sole control is for CSO reduction.

References:

TAWMS, "Feasibility Study and Costing of Proposed Pollution Control Measures in Humber Sewershed", Technical Report # 9, Toronto Area Watershed Management Strategy Study, January, 1986.

TAWMS CONTROL OPTION #18

Title:

Sewer separations

Description of Option:

To provide storm sewers in combined sewer area (in City of York) for intercepting stormwater runoff so that stormwater and sanitary sewage no longer combine.

Effect:

Water Quality:

1. What parameters controlled?
   Pollutant loadings from combined sewer overflow.
2. What source does it apply to?
   Local sewer networks.
3. What problem in the environment is controlled and where?
   Reduce combined sewer overflow but benefit is partly offset by increase in pollutant loadings to receiving waters from the storm sewers constructed for sewer separations.

Flood Control:

Yes, but City of York's sewer separation program offers protection against basement flooding in storms of up to 2 year recurrence intervals only. Existing sewers in City of York generally have capacities for storms up to 1.5 years recurrence intervals.

Treatment Costs:

Can reduce loadings to Humber WPCP.

Economics:

1. Capital costs.
   Exceedingly high; $84.7M to separate sewers for entire City of York.
2. Operating costs.
   Routine sewer maintenance.

Implementability and Social Impacts:

1. Likely implementor.
   Local municipality (City of York).
2. Impact on local residents.
   Inconvenience to road users during construction.
   Relief for basement flooding.
3. Jurisdictional conflicts.
   Not expected.

Evaluation Methodology:

Model simulation to estimate CSO reduction by reducing tributary combined sewer area. Identify from City of York's sewer separation scheme the areas equivalent to reduced area modelled. The City of York's scheme separates road drains only, not house connections. Estimate cost of separation.

Summary of Findings/Recommendations:

- The current program of sewer separation provides separate storm sewers to drain streets. To complete the program will require $17,250,000 for trunk sewers and $67,450,000 for local sewers, for a total of $84,700,000. Roof leaders and house laterals will remain connected to the combined sewers.
- To reconnect house laterals to the new storm sewers will require $127,000,000.
- Storm sewers discharge pollutants in stormwater directly to receiving waters. In other CSO control options, pollutants are intercepted and treated at the WPCP.
- City of York's sewer separation scheme offers basement flood protection against 2-year storm.
- Option not recommended.

References:

TAWMS, "Feasibility Study and Costing of Proposed Pollution Control Measures in Humber Sewershed", Technical Report # 9, Toronto Area Watershed Management Strategy Study, January, 1986.

TAWMS CONTROL OPTION #19

Title:

Landfill leachate controls in the flood plain

Description of Option:

Construction of landfill seal and leachate collection systems for subsequent treatment.

Effect:

Water Quality:

1. What parameters controlled?
   Site specific, could include metals, hazardous contaminants.
2. What source does it apply to?
   Groundwater leachate.
3. What problem in the environment is controlled and where?
   Leachate migration.

Flood Control:
None.

Treatment Costs:
Medium to high.

Economics:

1. Capital costs.
   High.
2. Operating costs.
   Medium to high.

Implementability and Social Impacts:

1. Likely implementor.
   Present owner.
2. Impact on local residents.
   Low.
3. Jurisdictional conflicts.
   Flood plain is under MTRCA jurisdiction.

Evaluation Methodology:

Site specific evaluation based on present methodology.

Summary of Findings/Recommendations:

Not investigated, to be identified only from direct abatement action plan, i.e. if investigation of sources points to a specific landfill, action will be taken. Sources in Humber River have been investigated and no problems have been identified.

TAWMS CONTROL OPTION #20

Title:

Dredging behind weirs and in the lower Humber River.

Description of Option:

Sediment removal from (a) behind weirs, and (b) the river reach downstream of Bloor Street.

Effect:

Water Quality:

1. What parameters controlled?
   Sediment and associated parameters (heavy metals, bacteria, etc.)
2. What source does it apply to?
   Surface washoff and erosion.
3. What problem in the environment is controlled and where?
   Will reduce resuspension of deposited material which can have a significant impact during storm events.

Flood Control:

May reduce backwater effects below Bloor Street.

Treatment Costs:

Disposal of dredged material at approved landfill site.

Economics:

1. Capital costs.
   Low (creation of access route as part of initial dredging).
2. Operating costs.
   Dredging - Medium
   Disposal - Medium

Implementability and Social Impacts:

1. Likely implementor.
   MTRCA.
2. Impact on local residents.
   None.
3. Jurisdictional conflicts.
   Dependant on area of disposal.

Evaluation Methodology:

An estimate of the annual load of sediment from the Humber watershed was made utilizing a statistical extrapolation of measured suspended sediment concentrations. This was compared with the amount of sediment that can be trapped behind the weirs and in the river reach below Bloor Street. Related research on sedimentation in Humber Marsh (below Bloor Street) is underway.

Summary of Findings/Recommendations:

- Amount contained behind weirs is approximately 3% of the annual load, therefore impact of dredging would be low. New weirs would not provide any more significant improvement than dredging existing dikes.

- Amount of sediment below Bloor Street is approximately 7% of the annual load, therefore impact of dredging would be low.

- Disposal of material in both cases would be difficult due to poor quality (i.e. no open lake disposal). This option should not be considered further for the Humber watershed.

- For more details, refer to detailed control option report to follow.

TORONTO AREA WATERSHED MANAGEMENT STRATEGY STUDY

CONTROL OPTION #20

DREDGING BEHIND WEIRS AND IN THE LOWER HUMBER

JUNE, 1985

Prepared by:

S.R. Klose
Water Resources Branch
Ministry of the Environment

1. Introduction

In a study of sediment transport and associated contaminant movement (1) it was shown that within the urbanized Humber River there is no long-term storage (i.e. year to year) of sediment. Thus sediment that is deposited during periods of low flow represents a potential source of contaminant input during rainfall and snowmelt events when they can be resuspended and transported into the Lake. A physical survey of the Humber River (2) identified the river reach downstream of Bloor Street as an area of sedimentation and that the 10 weirs between Highway 401 and Bloor Street represent local areas of sediment deposition. This option proposes removing these sediments and thus eliminating the potential for resuspension of the sediment and associated contaminants.

2. Results

Table 1 shows the amount of sediment trapped within the two areas along with the long term average sediment load.

TABLE 1

	Sediment Load (kg)	% of loading	Ref.
Annual Sediment Load	35.4×10^6	100	1
Spring Sediment Load	28.8×10^6	81	1
River reach below Bloor Street - Deposition	2.5×10^6	9 (of spring load)	1
Amount of sediment trapped by wiers	1.1×10^6	4 (of spring load)	2

The value reported for the river reach below Bloor Street represents the long term average deposition during the summer season (the spring season is a net scour period within this reach). Table 1 shows that the summer deposition represents approximately 9% of the spring load, thus if the spring freshet is removing the deposited load the impact of dredging would be relatively small. As well the amount contained behind the weirs is approximately 4% of the spring load. These numbers would be further reduced if dredging efficiency was considered.

The values listed in table 1 represent reductions in sediment only. In general, the load of contaminants moves with sediment as well as in a dissolved state (or associated to particles that require long settling times). Thus the effectiveness of dredging would be further reduced.

3. Summary

While the Humber River watershed produces a significant load of sediment of poor quality (1), only a small amount is trapped within the main channel. Thus removal of the deposited sediment would produce a small impact in reducing the loading.

References:

1. TAWMS, "Sediment Transport and Associated Contaminant Movement Within the Humber River", TAWMS - Technical Report # ,Draft, May, 1985.

2. TAWMS, "Physical Characteristics of the Humber River", TAWMS - Technical Report #3, March, 1984.

TAWMS CONTROL OPTION #21

Title:

Streambank Erosion Control

Description of Option:

Streambank works to reduce erosion and sediment transport/delivery from sources such as streambanks, valley walls, land areas adjacent to water courses.

Effect:

Water Quality:

1. What parameters controlled?
   Sediment and associated parameters (phosphorus, metals, organics and bacteria).
2. What source does it apply to?
   Streambanks and adjacent floodplain area.
3. What problem in the environment is controlled and where?
   Channel stability and downstream sedimentation.

Flood Control:

Benefit by reducing sedimentation - long term reduction in capital and operating costs of flood control structures.

Treatment Costs:

None.

Economics:

1. Capital costs.
   Major erosion sites: $1000/m of bank.
   Minor erosion sites: $80-$500/m of bank.
2. Operating costs.
   None.

Implementability and Social Impacts:

1. Likely implementor.
   MTRCA - currently MTRCA receives funding and identifies priority solely on the basis of hazard to life or structures, not based on severity of the erosion problem.
2. Impact on local residents.
   None - benefit through improvement of properties, parklands, etc.
3. Jurisdictional conflicts.
   None.

Evaluation Methodology:

MTRCA maintains an inventory of the degree of erosion occurring along the Humber River. Comparing this with the estimate of sediment load from the watershed will quantify the impact of streambank erosion.

Summary of Findings/Recommendations:

- Comparison of the estimate of sediment generated from streambank erosion with the annual sediment load, shows streambank erosion to be a significant source of sediment. The importance of reducing sediment in the Humber River from streambank erosion should be identified as a priority.

- For more details, refer to detailed control option report to follow.

TORONTO AREA WATERSHED MANAGEMENT STRATEGY STUDY

CONTROL OPTION #21

STREAMBANK EROSION CONTROL

June, 1985

Prepared by:

B. Hindley
MTRCA

1. Introduction

Streambank erosion (including sediment "eroded" from valley walls and land areas immediately adjacent to watercourses) can be a major contributor of sediment tc a watercourse directly and to a receiving water body such as Lake Ontario. The PLUARG program identified that 0-30% of the total sediment load from watercourses results from streambank erosion. Sediment represents a water quality concern for several reasons:

1) as a pollutant in silting fish spawning areas and eliminating other aquatic habitat, and in extreme cases causing direct mortality to aquatic life through clogging of gills and destroying filter feeding apparatus of aquatic organisms.
2) by acting as a transporter of contaminants such as phosphorus, trace metals, organics and bacteria. Also, the binding of contaminants may concentrate them above levels typically found in the water column.

Although it is generally accepted that the sediment load of a stream is ultimately reduced as the land base changes from agriculture to urban, the hydraulic changes in the stream as a result of this process tend to aggravate streambank erosion problems. The MTRCA has a streambank erosion control program to undertake erosion control projects on a priority basis and a monitoring program to annually prioritize sites for work. To date, findings from these projects have been approved based on hazard to life or structures. Sites that have been identified based on the magnitude of the sedimentation problem have not been funded.

2. Methods/Results

The MTRCA erosion site inventory provides an assessment of the degree of erosion in the Humber River. This includes collecting information on the length and height of the eroding bank on a site by site basis and also estimating the annual recession rate. This information is most extensive in the Lower Humber (below Steeles Avenue) and less extensive in the Upper Humber and its major tributaries. An estimate of the total annual sediment contribution from streambank erosion was obtained by calculating the total volume eroded based on the length, height and recession rate information and converting this to a mass. This value was then compared to the theoretical sediment yields for the Humber River contained in TAWMS Technical Report #3 "Physical Characteristics of the Humber River" (TAWMS, 1984). This suggests that 25-40% of the annual sediment yield from the Humber River is generated by streambank erosion. If this is a valid estimate, then the Humber River Basin falls at the high end of the PLUARG scale in terms of the significance of streambank erosion.

Streambank sediment, however, is generally composed of parent material rather than surficial soils, and likely contains lower concentrations of contaminants than sediment from overland point or

non-point sources. Thus its significance in causing a water quality concern is in its contribution of sediment, not its contribution of contaminants associated with sediment.

To evaluate benefit/cost of streambank erosion projects, as a general guide, a typical erosion control project for a 2m high bank would cost on the order of $1000/linear m (1977 dollars).

3. Summary/Conclusions

Streambank erosion represents a significant source of sediment in the Humber River, apparently a greater than typical proportion relative to other sources.

The importance of reducing sediment in the Humber River from streambank erosion should be identified as a priority because of its impact on water quality, habitat deterioration and potential hazard to aquatic life.

References:

1. TAWMS, "Physical Characteristics of the Humber River", Toronto Area Watershed Management Strategy Study, Technical Report #3, March, 1984.

TAWMS CONTROL OPTION #22

Title:

Additional flow augmentation from reservoirs

Description of Option:

This option would require the release of water from a reservoir during low flow to increase the assimilative capacity of the Humber River.

Effect:

Water Quality:

1. What parameters controlled?
   Helpful for BOD and bacteria, other parameters are diluted (metals, suspended solids, etc.).
2. What source does it apply to?
   Dry weather flow (groundwater, storm sewer).
3. What problem in the environment is controlled and where?
   Water quality is improved in entire river. No net reduction of loads to lake - existing reservoir. Could have poor water quality initially (=5yrs) - new reservoir. But net reductions of loads could be increased.

Flood Control:

Reservoir existing - some impact on operation for flood control.
New Reservoir - reduce flooding.

Treatment Costs:

None.

Economics:

1. Capital costs.
   Reservoir existing - none
   New Reservoir - high
2. Operating costs.
   Low

Implementability and Social Impacts:

1. Likely implementor.
   MTRCA
2. Impact on local residents.
   Changed operation of existing reservoir would affect recreation.
   New reservoir gives additional recreation.
3. Jurisdictional conflicts.
   Reservoir existing - (recreation considered highly important).
   New reservoir - obtaining land. Landowners at new reservoir site likely to object.

Evaluation Methodology:

MTRCA to indicate feasibility of increased flow augmentation. If feasible, flow alteration can be evaluated in systems model.

Summary of Findings/Recommendations:

- Alteration of the operation of Claireville reservoir is not feasible due to the poor water quality within the reservoir and the volume of water required to produce a significant dilution which would have an adverse affect on recreational activities. The construction of a new reservoir would have to be based on low flow augmentation alone. The environmental impact and economic losses would be too great.

- For more details, refer to detailed control option report to follow.

TORONTO AREA WATERSHED MANAGEMENT STRATEGY STUDY

CONTROL OPTION #22

ADDITIONAL FLOW AUGMENTATION FROM RESERVOIRS

June, 1985

Prepared by:

B. Hindley
MTRCA

1. Introduction

This option would require release of water from a flood control reservoir during low flow to increase the assimilative capacity of the Humber River. Currently the reservoir at Claireville on the West Humber River is the only impoundment of significance as a flood control structure in the Humber Watershed. In the 1950's a series of 13 reservoirs within the MTRCA jurisdiction were proposed including 6 on the Humber River (Claireville, Ebenezer, Nashville, Bolton, Lower East and King Creek). These reservoirs were never constructed, in part because of the limited downstream benefits for flood control, and an ambitious program of floodplain lands acquisition, onsite flood control works and flood plain regulation.

The effect of low flow augmentation would be a general improvement in water quality in the lower portion of the Humber River during periods of low flow. Improvements anticipated include a reduction in suspended solids, BOD, bacteria and sediment associated contaminants and dilution of other parameters present in higher concentrations downstream.

2. Methods/Results

Implementation of this control option would occur at two levels:

1) alter the operation of Claireville, the only existing reservoir
2) construct new reservoirs

1) Alter operation of Claireville - Claireville is currently operated as a multiuse reservoir with emphasis on spring flood storage and summer recreation. It is located on the West Humber River, which empties into the main Humber River near Albion Road and Islington Avenue.

   The West Humber River watershed is largely within the Peel plain and because it drains a largely impermeable land area, base flows are low and the river responds relatively rapidly to snowmelt and storm events. Under low flow conditions, the West Humber probably contributes less than 5% of the Humber River flow at their confluence. As a result, water level maintenance in the reservoir to maintain recreational activities is more dependant on storm events than base flow. It is, therefore, not feasible to provide any degree of low flow augmentation through the summer without restricting recreational opportunities.

   A cursory examination of water quality entering and leaving the reservoir has shown that Claireville does not provide improvements in water quality downstream, typical of other onstream reservoirs. Levels of BOD, suspended sediment, phosphorus and zinc at the outlet of Claireville were not significantly different from the inflow and in some cases exceeded MOE PWQO's. An improvement in microbiological parameters did occur. It would appear that the water quality in Claireville is sufficiently degraded to the extent that low flow augmentation would not necessarily result in an improvement in river water quality.

Since the West Humber flow during dry weather represents only a small proportion of the total flow of the Humber at their confluence, a substantial flow increase would be required at the outlet of Claireville to provide significant dilution to the main Humber. This would result in substantial drawdown at the reservoir.

2) Upstream reservoirs are no longer required for flood control on the Humber River since onsite works, land acquisitions, flood plain regulation and flood warning activities have been successful. The justification for constructing one of these reservoirs would, therefore, have to be based on low flow augmentation to improve downstream water quality. This would not be cost effective and would have substantial environmental and economic impacts upstream.

3. Summary/Recommendations

It is not feasible to alter the operation at the existing reservoir on the Humber River to improve water quality because of poor outlet water quality and the volume of water required to cause significant dilution of flow in the Humber River below its confluence with the West Humber River.

The construction of a new reservoir would not be cost effective since it would have to be justified based on low flow augmentation only and upstream environmental and economic losses would be too great.

TAWMS CONTROL OPTION #23

Title:

Agricultural - erosion and sediment control through conservation tillage, and structural erosion control measures

Description of Option:

Minimum or no-till operations, crop rotation, contour plowing, buffer strips, grassed waterways.

Effect:

Water Quality:

1. What parameters controlled?
   Suspended solids, nutrients, pesticides and herbicides.
2. What source does it apply to?
   Upper Humber, active agricultural land use.
3. What problem in the environment is controlled and where?
   Soil erosion, instream sedimentation, local as well as downstream WQ impairment.

Flood Control:

Some due to decreased volume and velocity of runoff and lower sediment load to stream.

Treatment Costs:

None.

Economics:

1. Capital costs.
   Medium - may require extension personnel for educational program to phase in future alternative equipment (may result in net benefit).
2. Operating costs.
   Low - offers other benefits to farmer which offset costs.

Implementability and Social Impacts:

1. Likely implementor.
   Farmer and OMAF.
2. Impact on local residents.
   Some due to decreased sediment loading. Farmer incurs cost for new equipment, but he also incurs benefits.
3. Jurisdictional conflicts.
   Lead agency conflict - can be resolved by readily obtained agreement OMAF/Conservation Authority.

Evaluation Methodology:

Program to be further evaluated in proposal for future work as an extension to Upper Humber Study.

Summary of Findings/Recommendations:

- The Upper Humber River Water Quality Study (TAWMS, TR#8, 1986), identified a number of "diffuse" problems in the upper Humber watershed that collectively result in water quality degradation. A relatively low cost program could be initiated: however, a change in the grant structure would be required. Presently, there is a 50% government grant available (to a maximum of $7.5K) for construction of grassed waterways.

- For more details, refer to detailed control option report following option summary sheet #25.

TAWMS CONTROL OPTION #24

Title:

Agricultural - cattle access control

Description of Option:

Streambank fencing, restricted access, concrete walkways, possible pumping facilities (alternate waterway facilities).

Effect:

Water Quality:

1. What parameters controlled?
   Suspended solids, nutrients, bacteria.
2. What source does it apply to?
   Upper Humber, active agricultural land use.
3. What problem in the environment is controlled and where?
   Streambank erosion, direct input of nutrients and bacteria to stream, local as well as downstream effect.

Flood Control:

None.

Treatment Costs:

None.

Economics:

1. Capital costs.
   Low-moderate.
2. Operating costs.
   Minimal.

Implementability and Social Impacts:

1. Likely implementor.
   Local farmers and OMAF, possibly MTRCA.
   - stream improvement program (MNR).
   - offstream sediment control program.
2. Impact on local residents.
   Little.
3. Jurisdictional conflicts.
   Funding.

Evaluation Methodology:

Problem to be assessed as part of the Upper Humber River Water Quality Study.

Summary of Findings/Recommendations:

- The Upper Humber River Water Quality Study (TAWMS, TR#8, 1986) identified a number of "diffuse" problems in the upper Humber watershed that collectively result in water quality degradation. A relatively low cost program was already initiated: however, a change in the grant structure may be required to include further incentives. The present grant structuring makes funds available through OMAF (OSCEPAP program) for fencing (50% grant, maximum $7.5K).

- For more details, refer to detailed control option report following option summary sheet #25.

TAWMS CONTROL OPTION #25

Title:

Agricultural - manure storage and spreading methods

Description of Option:

Improved holding facilities and proper siting, change in farm operation practice.

Effect:

Water Quality:

1. What parameters controlled?
   Nutrients, BOD, Bacteria.
2. What source does it apply to?
   upper Humber, active agricultural land use.
3. What problem in the environment is controlled and where?
   Instream bacteria, mainly local effects with some additional downstream WQ impairment.

Flood Control:

None.

Treatment Costs:

Mainly capital costs.

Economics:

1. Capital costs.
   High (some funding support is already available).
2. Operating costs.
   Low (manure spreading).

Implementability and Social Impacts:

1. Likely implementor.
   Farmer, MOE, OMAF.
2. Impact on local residents.
   None.
3. Jurisdictional conflicts.
   Land agency conflict - OMAF/MOE.

Evaluation Methodology:

Problem to be assessed as part of the upper Humber River Water Quality Study.

Summary of Findings/Recommendations:

- The Upper Humber River Water Quality Study (TAWMS, TR#8, 1986) identified a number of "diffuse" problems in the upper Humber watershed that collectively result in water quality degradation. Grant structure is already available through OMAF (OSCEPAP program) - 1/3 government grant to $5.0K maximum available.

- For more details, refer to detailed control option report to follow.

TORONTO AREA WATERSHED MANAGEMENT STRATEGY STUDY

CONTROL OPTION #23

AGRICULTURAL - EROSION AND SEDIMENT CONTROL THROUGH CONSERVATION TILLAGE

CONTROL OPTION #24

AGRICULTURAL - CATTLE ACCESS CONTROL

CONTROL OPTION #25

AGRICULTURAL - MANURE HANDLING AND SPREADING PROBLEMS

June, 1985

Prepared by:

B. Hindley
MTRCA

1. Introduction

Each of these problems have been addressed in some fashion through the "Upper Humber Water Quality Study" (TAWMS, TR#8, 1985) and the problem has been identified as one which occurs regularly (i.e. cattle access and overland sediment/pollutant delivery from rural lands) in all parts of the watershed; in particular, through the southern parts of the Oak Ridges Moraine and on the Peel Plain.

Measures to control these problems are relatively low cost and agencies such as MOE and OMAF have special grant assistance programs to deal with these. The problem in dealing with them is in regard to the priority system which exists for administering grants (i.e. southwestern Ontario and Lake Simcoe have high priority; Lake Ontario drainage basins have low priority) and the inflexibility of the criteria for grant eligibility (tenants, hobby farmers, nonfarming owners (leasors) do not quality for grants).

2. Summary/Recommendations

It should be recognized that these "diffuse" problems exist in the upper Humber River and that while on a site by site basis they do not constitute a major problem, collectively they result in water quality degradation that affects recreational facilities such as Boyd and Claireville recreational areas.

A relatively low cost program, through existing grants would have a positive effect in terms of improving water quality (though not directly measurable) and a positive effect in terms of public relations for the TAWMS program.

The existing government programs (OSCEPAP) may provide for better utilization for available grants and give greater priority to the Humber River since rural abatement is part of a water quality improvement exercise. A major water quality improvement may require additional programs.

TAWMS CONTROL OPTION #26

Title:

Agricultural - illegal connections to drainage tile

Description of Option:

Tracing and disconnecting improper or illegal connections to field tile drains. Enforcement of drainage guidelines.

Effect:

Water Quality:

1. What parameters controlled?
   Bacteria, Nutrients, BOD, Metals.
2. What source does it apply to?
   Upper Humber, active agricultural land use.
3. What problem in the environment is controlled and where?
   Instream bacteria and nutrients, excessive algae growth, possible fish kills, more local problems.

Flood Control:
None.

Treatment Costs:
Low-moderate.

Economics:

1. Capital costs.
   Low-moderate.
2. Operating costs.
   Policing/monitoring program - labour intensive, moderate-high cost.

Implementability and Social Impacts:

1. Likely implementor.
   MOE to locate illegal connections.
   Farmer to correct operation.
2. Impact on local residents.
   None.
3. Jurisdictional conflicts.
   MOE/OMAF - What is best approach to correct problem - prosecution, abatement or education, grants.

Evaluation Methodology:

Outfall monitoring, tile field mapping (existing and historical) and direct abatement program.

Summary of Findings/Recommendations:

Not investigated, to be identified only from direct abatement action plan, i.e. if investigation of sources points to a specific problem, action will be taken.

TAWMS CONTROL OPTION #27

Title:

Municipal - septic tank malfunctions

Description of Option:

Rural residences and some small urban centres are served by septic tank and tile disposal systems. An unknown fraction of these malfunction, with a resulting discharge to surface waters of sanitary wastes. A control program would require a monitoring effort to locate malfunctioning systems followed by remedial action.

Effect:

Water Quality:

1. What parameters controlled?
   Sanitary waste material - BOD, bacteria, phosphorus, ammonia.
2. What source does it apply to?
   Distributed rural sources, with main concentration in small villages.
3. What problem in the environment is controlled and where?
   Background bacteria pollution in Upper Humber (and other parameters).

Flood Control:

None.

Treatment Costs:

None.

Economics:

1. Capital costs.
   Corrective measures would have a cost to individual homeowners.
2. Operating costs.
   Follow-up studies have some cost.

Implementability and Social Impacts:

1. Likely implementor.
   MOE or health units to do studies. Homeowners to make corrections. MOE to subsidize replacement with communal systems, if appropriate.
2. Impact on local residents.
   Some individual homeowners may incur costs.
   Potential for improved water quality in wells.
3. Jurisdictional conflicts.
   None likely.

Evaluation Methodology:

Preliminary evaluation would need to estimate number of septic tank systems. Site specific evaluation based on present methodology.

Summary of Findings/Recommendations:

Not investigated, to be identified only from direct abatement action plan, i.e. if investigation of sources points to a specific problem, action will be taken.

TAWMS CONTROL OPTION #28

Title:

Municipal - control storm runoff on new developments

Description of Option:

Implementation of modern stormwater management practices to reduce runoff rates and pollutant loadings.

Effect:

Water Quality:

1. What parameters controlled?
   Parameters associated with urban stormwater runoff such as nutrients, metals, sediment, bacteria.
2. What source does it apply to?
   Urban stormwater runoff - overland flow.
3. What problem in the environment is controlled and where?
   Additional runoff rates and pollutant loading from new urban developments.

Flood Control:

Reduction of peak flows to watercourse. Basement flooding averted by using major-minor system techniques.

Treatment Costs:

If applicable.

Economics:

1. Capital costs.
   Low-medium.
2. Operating costs.
   Low.

Implementability and Social Impacts:

1. Likely implementor.
   Municipality and land developer.
2. Impact on local residents.
   None.
3. Jurisdictional conflicts.
   None.

Evaluation Methodology:

Has not been specifically evaluated for adaptation in this study. Ties in closely with erosion and sediment control. Estimate of future development provided by MTRCA.

Summary of Findings/Recommendations:

- Techniques are generally not well quantified. They tend to maintain existing hydrological regime and quality.

- The change in land use from open space, forest and pasture to developed areas will be less than 1% (approximately 5.4 sq. km.) of the total area of the Humber watershed (911 sq. km.), over the period 1983 to the year 2000. While the impact of storm runoff control on new developments may be difficult to quantify, techniques should be recommended for implementation. The Province is developing urban drainage guidelines.

TAWMS CONTROL OPTION #29

Title:

Municipal - erosion and sediment control on construction sites.

Description of Option:

Urban land developers would be required to prepare a sediment and erosion control plan as part of the subdivision review and approval process. The plan would include measures to avoid erosion on site and to trap sediment leaving the site. In simple cases the minimum effort of "good housekeeping" would be required.

Effect:

Water Quality:

1. What parameters controlled?
   Sediment, sediment associated pollutants (metals, nutrients).
2. What source does it apply to?
   Urban construction primarily in the upper Humber/ Some new development and redevelopment in lower Humber.
3. What problem in the environment is controlled and where?
   Turbidity in Humber River. Degraded fishery in entire Humber. Sediment buildup in Humber Bay. Phosphorus loads to Lake Ontario.

Flood Control:

No effect.

Treatment Costs:

No effect. Related to channel erosion control.

Economics:

1. Capital costs.
   Low. Borne by developer (ultimately home owner).
2. Operating costs.
   Some costs to plan reviewer, inspector and developer.

Implementability and Social Impacts:

1. Likely implementor.
   Developer with inspection by municipality. Technical support and review support from Conservation Authorities and Province.
2. Impact on local residents.
   No impact.
3. Jurisdictional conflicts.
   To be resolved when Ontario's Urban Drainage Policy is developed.

Evaluation Methodology:

No evaluation required. Current status of Urban Drainage Policy should be reflected in the final report. Experience of MTRCA should be reflected as well. Should evaluate how effectively sediment control measures are carried out by developers.

Summary of Findings/Recommendations:

The guidelines for erosion and sediment control on construction sites are adopted by the municipalities. It is the responsibility of the developer/contractor to implement the control measures. There is limited MTRCA experience with the measures' effectiveness. It is not certain how effective the control measures are and to what extent they are carried out by the developers.

Perhaps further study by the municipalities to investigate the effectiveness of the control measures is desirable.

TAWMS CONTROL OPTION # 30

Title: Flow Disinfection

Description of Option:

Apply Ultra-Violet (UV) light disinfection technology to control bacterial contamination in major tributaries during dry weather flow conditions (and partially controlled during wet weather)

Effect:

Water Quality:

1. What Parameters Controlled?
   Bacterial organisms such as fecal coliforms, E. Coli, pseudomonas aerugenosa, etc.
2. What Source Does it Apply to?
   Bacterial contamination during dry weather. Partial treatment of water during wet weather flows.
3. What Problem in the Environment is Controlled and Where?
   Bacterial contamination of the Humber River from tributaries is controlled, however, no improvement in the tributaries will be attained.

Flood Control: NA

Treatment Costs: NA

Economics:

1. Capital Costs.
   $150,000 per unit (see detailed report to follow)
2. Operating Costs.
   $7,140/year per unit for year round operation
   $5,280/year per unit for seasonal operation (April 1 to November 1)

Implementability and Social Impacts:

1. Likely Implementor
   Municipality

2. Impact on Local Residents
   No impact. A small, section of a tributary would have to be isolated for the UV Disinfection Process.

3. Jurisdictional Conflicts.
   Not expected.

Evaluation Methodology:

- Past experience with the application/operation of UV disinfection technology in high quality secondary sewage treatment plants.
- Limited bench scale testing of UV Disinfection Efficiency carried out at Black Creek (see detailed report to follow)

Detailed Costing:

CAPITAL COSTS:

Installing units at Black Creek and Emery Creek to treat dry weather flow
@ $150,000 x 2 = $300,000

ANNUAL COSTS:

Periodic replacement of UV lamps and periodic cleaning of trash and debris from the screens.

For year round operation

@ $7,140/yr x 2 = $14,280/yr.

For seasonal operation (April 1 to Nov. 1)

@ $5,280/yr x 2 = $10,560/yr.

Note: Installation costs may be drastically higher for different site specific conditions (eg. pumping water out to treat it)

Summary/Recommendations

It is technically feasible to control bacterial contamination at Black Creek with UV Disinfection Process. Field study (using Pilot Scale Equipment), however, should be carried out at Black Creek for at least 3 periods of 2 weeks each (Spring, Summer and Fall) to more accurately identify process design/operating requirements and economics.

TORONTO AREA WATERSHED MANAGEMENT STRATEGY STUDY

CONTROL OPTION #30

FLOW DISINFECTION

September, 1985

Prepared by:

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Water Resources Branch
Ministry of the Environment

1.0 Introduction

The control of bacterial contamination of the Humber River through tracing and eliminating priority outfalls may not be fully effective. The use of disinfection techniques to reduce bacterial loadings from low flow in high priority areas (Black Creek, Emery Creek) may be a practical interim measure. Disinfection will be carried out by Ultra-Violet (UV) irradiation. This technique is also compatible with stormwater retention ponds for increased control of bacteria.

2.0 Preliminary Process Design and Cost Estimation For Disinfecting Black Creek Dry Weather Flow with Ultra-Violet Light

Bench scale tests are being carried out at the Black Creek to investigate the optimum UV dosage required to reduce fecal coliform counts in the dry weather flow to less than 100/100 ml. Only the first run results are available today. Table A.2 in Appendix 2 shows that fecal coliforms were effectively reduced from 3,400/100 ml to <100/100 ml with a dosage of 10.8 watts-sec/L. It is summarized that the optimum UV dosage most likely will be in the range of 5 watt-sec/L. (More experimental results will be available at a later date). At the present time, UV disinfection is generally designed to provide 8 to 12 watts-sec/L dosage in secondary and tertiary treated sewage works effluent.

The design basis used to estimate the capital and annual operating and maintenance costs for disinfecting the Black Creek dry weather flow are summarized as follows:

Optimum UV dosage required	5 watt-sec/L
Maximum flow to be fully disinfected	$0.2 m^3/sec$ or 200 L/sec
"Average" Power output per UV lamp (G36T6 type lamp)	10.4 Watts
Number of UV Lamps required	(200x5x1/10.4)=96
Number of UV Lamps assumed	"100"

Based on the above reactor design, preliminary capital and operating and maintenance costs are estimated as follows:

Capital Cost for the UV Reactor

100 lamp reactor at $750/lamp	$75,000
Installation Cost (Including engineering design, gratings, heavy-duty steel covers for the reactor, extra long electrical wire required for installing the Power panel above the flood plain, etc.)	$55,000
Contingency at approx. 15% of the above	$20,000
Total	$150,000

Annual Operating and Maintenance Costs

A: Year Round Operation

Electric Power Cost (36 watts/lamp x 100 lampsx24 hrs/dayx365dayx$0.03x10^{-3}/watts)	$950
Cost for regular maintenance/Inspection (2 hrs/week x 52 weeks x $12/hr)	$1,250
Inspection and Maintenance after wet weather events (4hrs/event x 30 events/yr x 12/hr)	$1,440
Lamp replacement Cost* (100 lamps/2 yrs x $50/lamp)	$2,500
Quartz Sheath Replacement Cost (100 sheaths/10 yr x 100/sheath)	$1,000
Total Operating and Maintenance Cost	$7,140

* Based on the experience accumulated at the Tillsonberg STP in Ontario, average life for UV lamps is 2 years or longer, eventhough it is being quoted at 8400 hr by lamp manufacturers.

B: Seasonal Disinfection (April 1 to November 1)

Electric Power Cost: (36 Watts/lamp x 100 lamps x 24 hr/day x 214 days x$0.03x10^{-3}/watts)	$560
Cost for regular maintenance/inspection (2hr/week x4 weeks/month x 7 months x $12/hr)	$670
Cost for assembling/disassembling UV reactor (2 men/crew x 2 day/year x 8hr/day x $12/hr)	$390
Cost for maintenance/inspection after wet weather events (4hrs/events x 20 events/season x $12/hr)	$960
Lamp replacement cost (100 lamps/3 yrs x$50/lamp)	$1,700
Quartz sheath replacement cost (100 sheaths/10 yr x $100/sheath)	$1,000
Total Operating amd Maintenance cost	$5,280

3.0 Preliminary Field Results Obtained with Disinfecting Black Creek (at Scarlett Road) Dry Weather Flow

Table A.1 Background information

Dry weather FC counts: 2418 (based on outfall survey)

Short term survey results, Sept/Oct 1985

Date	FC_u	% T (254)	TURB (JTU)	Weather condition
20/9	-	70	4.3	DRY
23/9	6.6 E3	71	3.2	DRY
24/9	(1.2 E4)	31	30	WET
25/9	2.0 E4	59	4.0	DRY
26/9	3.7 E4	47	20	DRY
30/9	2.6 E3	8.0	-	DRY
01/10	-	56	-	WET
GM	10.8E3			

Table A.2 Pilot Scale UV Reactor Disinfection Results from First Run

UV dosage (watt-sec/L)	contact time (seconds)	FC_r/100ml	$\log(FC_r/FC_u)$
10.8	1.0	<100	-1.41
13.0	1.2	<100	-1.41
32.3	3.0	<100	-1.41
66.7	6.0	<100	-1.4
109	10.0	<20	-2.22
217	20.0	<20	-2.11

Initial fecal coliform counts (FC_u) = 3,400/100ml
FC_r = fecal coliform counts after reduction
% UV transmission of the Black Creek Water disinfected = 80%.

4.0 Summary/Recommendations

It is technically feasible to control bacterial contamination at Black Creek with UV Disinfection Process. Field study (using Pilot Scale Equipment), however, should be carried out at Black Creek for at least 3 periods of 2 weeks each (Spring, Summer and Fall) to more accurately identify process design/operating requirements and economics.